JAN 31 1929

The Engineer.

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The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Belvedere road, Lambeth, London, S.E. 1, invites TENDERS for :—
SCHEDULE 1.—220 STEEL AXLES for ROLLING STOCK.
SCHEDULE 2.—About 320 TONS of FISH-PLATES for 90 lb. RAILS.
SCHEDULE 3.—3 STEEL BARGES, Hopper Capacity 100 Tons.
SCHEDULE 4.—ONE 85ft. TURNTABLE for LOCOMOTIVES, 5ft. 6in. Gauge.
Tenders due as follows :—
Schedules 1, 2 and 3, 25th January, 1929.
Schedule 4, 20th February, 1929.
Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 677

Crown Agents for the COLONIES, COLONIAL GOVERNMENT APPOINTMENTS.
APPLICATIONS from qualified candidates are INVITED for the following POSTS :—
M/906.—WATERWORKS ENGINEER REQUIRED by the GOVERNMENT of NIGERIA for the Public Works Department for two tours of 12 to 18 months' service, with possible extension. Salary £800, rising by annual increments of £40 to £920 a year; seniority allowance of £72 a year whilst on duty in the Colony. Free quarters, passages and liberal leave with full salary. Candidates, between 30 and 40 years of age, must possess a thorough knowledge of and experience in design and construction of Waterworks and in the investigation of Water Supplies in the Tropics and elsewhere. Must be Corporate Members of the Institution of Civil Engineers.
M/1188.—ASSISTANT ACCOUNTANTS (2) REQUIRED by the GOVERNMENT of NIGERIA for the Railway Department for two tours of 18 months' service, with possible permanency. Salary £400 a year, rising to £720 a year by annual increments. Outfit allowance of £60 on first appointment. Free passages and quarters, liberal leave on full salary. Candidates, aged 23 to 30 years, must have experience of Office Organisation and Accounts in a Civil Engineer's Office, preferably Railway, and should be in possession of an Accounting Certificate to the Royal Society of Arts standard.
Apply at once by letter, stating age and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W.1, quoting the reference number against the appointment for which application is made. 678

Gold Coast.
A PRINCIPAL is REQUIRED for the Government Technical School, Accra, Gold Coast. Candidates should be University graduates in Engineering or should possess some similar recognised technical qualification, and should be not more than 35 years of age. Salary at the rate of £960 per annum with a duty allowance of £96 per annum, payable whilst the Principal is on duty in the Colony. Free first-class passage and free quarters provided.—Further information may be obtained on application to C.A. (D), the SECRETARY, Board of Education, Whitehall, London, S.W.1. Scottish candidates should apply to (D), the SECRETARY, Scottish Education Department, Whitehall, London, S.W.1. The list of applications will close on 28th January. 583

R.A. 2661.

Ministry of Transport.
ARTERIAL ROADS, GREATER LONDON.
NORTH CIRCULAR ROAD, ESSEX, WADHAM-ROAD, WALTHAMSTOW.
CONSTRUCTION OF A BRIDGE OVER THE LONDON AND NORTH-EASTERN RAILWAY, &c.
The Minister is prepared to receive TENDERS for the CONSTRUCTION of the above-mentioned BRIDGE and APPROACHES of REINFORCED CONCRETE, with APPROACH EMBANKMENTS and DIVERSIONS of PARTS of ADJACENT ROADS, and a small WIDENING at Wadham Lodge Farm, and including the maintenance of railway and road traffic through the site of the works.
Forms of Tender, conditions of Tender, conditions of contract, bills of quantities and specification may be obtained from, and drawings may be inspected at, the office of the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, on and after the 21st January, 1929, upon payment of a deposit of £25.
This amount will be returned to the tenderer if his Tender is a bona fide one and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.
Preference will be given to contractors who have had previous experience of similar work.
Tenders, on the official form, accompanied by a fully priced bill of quantities and schedules of prices, and enclosed in a sealed envelope, endorsed "Tender for the Construction of Wadham-road Bridge, &c.," must reach the undersigned by 10 a.m. on Monday, the 11th February, 1929.
The Minister does not bind himself to accept the lowest or any Tender.
Dated this 4th day of January, 1929.
H. H. PIGGOTT,
Assistant Secretary.
Roads Department, Ministry of Transport. 675

The Government of INDIA REQUIRE an ASSISTANT FOREMAN for CASE and CUPPING SECTION, METAL and STEEL FACTORY, ISHAPORE (APPOINTMENT 112).
Must be a qualified apprenticed mechanic with experience in small arms, Q.F. Case, and other metal pressing work, and be qualified to design and construct fittings and tools required for such work. Age not more than 35 years. Capable of controlling labour. TERMS.—Salary Rs. 450-15-510 per mensem, with prospects of further increases. Agreement five years in first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination.—Further particulars and forms of application may be obtained (on request by postcard quoting number of appointment) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 26th January, 1929. 636

University of London.
A COURSE of FOUR LECTURES on "SOME APPLICATIONS OF PHYSICAL CHEMISTRY TO STEEL MANUFACTURE" (with lantern illustrations) will be given by Dr. ANDREW McCANCE, D.Sc. (Managing Director, Clyde Alloy Steel Co., Ltd.), at the IMPERIAL COLLEGE, ROYAL SCHOOL OF MINES (Prince Consort-road, S.W. 7), on JANUARY 23rd, 24th, 30th, and 31st, at 5.30 p.m. At the First Lecture the chair will be taken by F. W. Harbord, Esq., C.B.E. (late President of the Iron and Steel Institute).
ADMISSION FREE, WITHOUT TICKET.
EDWIN DELLER,
639 Academic Registrar.

PUBLIC NOTICES

Armstrong College,
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
223 Newcastle-upon-Tyne.

City of Chichester.
TENDER FOR MACHINERY.
The Town Council invite TENDERS for the SUPPLY and ERECTION of a 40-kW MOTOR GENERATOR for the Outfall Works, Apuldram, near Chichester, to convert 415 volts, 3-phase, 50-cycles A.C. to 120/130 D.C. To be complete with necessary 3-phase Starting Panel and with Shunt Regulator for D.C. side and other appurtenant gear.
Any further details can be obtained from the City Engineer, Mr. Frank J. Lobley, A.M. Inst. C.E., "Greyfriars," North-street, Chichester, during the usual office hours.
Sealed Tenders, endorsed "Outfall Machinery," must reach me not later than the first postal delivery on Monday, the 28th day of January, 1929.
The Council do not bind themselves to accept the lowest or any Tender.
J. W. LOADER COOPER,
Town Clerk.
3rd January, 1929. 627

PUBLIC NOTICES

Sunderland Education Committee.
THE TECHNICAL COLLEGE.
DEPARTMENT OF MECHANICAL AND CIVIL ENGINEERING.
The Committee invite APPLICATIONS for the POSITION of HEAD of the MECHANICAL and CIVIL ENGINEERING DEPARTMENT. Applicants must possess an Honours Degree and have had good drawing-office and works experience.
The standard of the full-time day courses is that required for an Honours University Degree, and that of the part-time evening courses for Senior and Advanced Students from the marine engineering drawing-offices and works of the district desiring the Ordinary and Higher National Certificates of the Institution of Mechanical Engineers. Experience in all types of prime movers, steam and oil, is desirable.
Salary scale £600-£25-£700, less 5 per cent. for superannuation.
Application forms can be obtained from the undersigned and should be returned not later than Saturday, 9th February, 1929.
HERBERT REED,
Chief Education Officer.
Education Offices,
15, John-street, Sunderland,
7th January, 1929. 667

Luton Union.
BEECH HILL CHILDREN'S HOMES.
WATER SOFTENING PLANT.
TENDERS are INVITED for the SUPPLYING and FIXING to the existing main of a suitable WATER SOFTENING PLANT at the Children's Homes, Beech Hill, Luton, of approximately 900 gallons capacity.
Tenders should include for alteration to existing water supply in order to divert the W.C. cisterns from the soft to the hard water supply and include for making good to the building and decorations where disturbed to the satisfaction of the Architect.
Further particulars can be obtained from the Architect, Mr. W. H. Guest Hubbard, M.S.A., 35, Manchester-street, Luton.
Tenders must be received by the undersigned not later than 10 a.m. on Friday, the 25th January, 1929.
The Guardians do not bind themselves to accept the lowest or any Tender.
EVAN A. C. EVANS,
Clerk to the Guardians.
Bedford Chambers, Manchester-street, Luton,
4th January, 1929. 624

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY CO.
The Directors are prepared to receive up to Noon on Wednesday, 23rd January, TENDERS for the SUPPLY of :—
1. CHEMICALLY DRESSED WAGON COVERS, &c.
2. WOOD SCREWS, SPLIT PINS, &c.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices, The White Mansion, 91, Petty France, Westminster, S.W. 1,
7th January, 1929. 655

Metropolitan Water Board.
TENDERS FOR SUPPLY OF PHOTO PRINTS, &c.
The Metropolitan Water Board invite TENDERS for the SUPPLY of PHOTO PRINTS, &c., to their Head Office for the period of twelve months commencing 1st April, 1929.
Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 7th January, 1929, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope. Samples of the paper required can be seen at the offices of the Board (Room 201).
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Photo Prints, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 6th February, 1929.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board, 173, Rosebery-avenue, Clerkenwell, E.C. 1,
1st January, 1929. 601

Metropolitan Water Board.
TENDERS FOR PIPE LAYING, &c.
The Metropolitan Water Board invite TENDERS for PIPE LAYING, ALTERATIONS and BRICKLAYERS' WORK within the areas of their Kent, Northern, Southern and Western Districts, for the period of twelve months commencing 1st April, 1929.
Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after 7th January, 1929, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Pipe Laying, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 6th February, 1929.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board, 173, Rosebery-avenue, Clerkenwell, E.C. 1,
1st January, 1929. 602

Metropolitan Water Board.
TENDERS FOR THE SUPPLY OF CAST IRON PIPES, SLUICE VALVES AND HYDRANTS.
The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for periods of 6 and 12 months, commencing 1st April, 1929 :—
Tender No.
3. Cast Iron Straight and Irregular Pipes.
21. Sluice Valves and Spindles, Fire Hydrants, &c.
Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on or after Monday, 7th January, 1929, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.
Applicants should refer to the number of the Tender for which forms are required.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board not later than 11 a.m. on Wednesday, 6th February, 1929.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board, 173, Rosebery-avenue, Clerkenwell, E.C. 1,
1st January, 1929. 603

Borough of Keighley.
APPOINTMENT OF WATER ENGINEER.
APPLICATIONS are INVITED from duly qualified Water Engineers for the above APPOINTMENT at a commencing salary of £500 per annum.
The post is a designated one under the Local Government and other Officers' Superannuation Act, 1922, and the appointment will be made subject to medical examination.
Applications, on form to be obtained from the undersigned, marked "Water Engineer" and accompanied by copies of three recent testimonials, must be delivered to me not later than the 25th January, 1929.
S. WALKER,
Town Clerk.
Town Hall, Keighley,
4th January, 1929. 620

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PUBLIC NOTICES

City of Sheffield.

ELECTRIC SUPPLY DEPARTMENT.
NEW ELECTRICITY GENERATING STATION.

The Electric Supply Committee invite TENDERS as follows for WORKS and PLANT required in connection with the equipment of a New Electricity Generating Station at Blackburn Meadows, Sheffield :—

SPECIFICATION B.M. 67.—Turbo-alternator, including Condensing, Evaporating and Steam Preheating Plant.

SPECIFICATION B.M. 68.—Water-tube Boilers, with Chimneys, Superheaters, Stokers (or Pulverised Fuel Firing Equipment), Economisers, Valves, Pipe Work and all Accessories.

SPECIFICATION B.M. 70.—Wagon Tippers, Conveyors and Elevators.

SPECIFICATION B.M. 72.—Cooling Towers.

SPECIFICATION B.M. 73.—Overhead Electrically and Hand-operated Travelling Cranes.

Contractors desiring to submit Tenders may see the drawings and obtain the separate specifications and forms of Tender at these offices on and after Saturday, 12th January, 1929, on making a deposit of £3 3s. in respect of each specification, which sum will be refunded on receipt of a bona fide Tender. Additional copies of the specifications may be purchased at a cost of 10s. 6d. per copy.

Any person or firm sending in a Tender will be required to add a schedule to such Tender, stating the names of the various classes of labour which he or they intend to employ, together with the place where such labour will be employed, and the rates of wages, hours of labour and conditions of employment to be paid and observed in respect of each class of labour, all of which as shown in such schedule shall comply with the City Council's form of clauses respecting wages, hours and conditions of labour and prohibition against assigning and sub-letting.

Tenders, which must be made out on the official Tender form, to be delivered at these offices (enclosed in the official envelope provided) not later than Noon on Thursday, 14th February, 1929.

The Committee do not bind themselves to accept the lowest or any Tender.

S. E. FEDDEN, M. Inst. C.E.,
General Manager and Engineer.

Commercial-street, Sheffield. 641

Borough of Richmond (Surrey).

WATER ENGINEER'S DEPARTMENT.
TEMPORARY ENGINEERING ASSISTANT.

APPLICATIONS are INVITED from Associate Members of the Institution of Civil Engineers for the APPOINTMENT of a TEMPORARY ENGINEERING ASSISTANT, at a salary of not exceeding £7 7s. per week.

Candidates must be good surveyors and draughtsmen and have had experience in the design of and preparation of specifications and quantities for pumping stations, concrete reservoirs and water mains.

Applications, stating age, qualifications, experience, and salary required and accompanied by copies of three recent testimonials, to be forwarded to Mr. Hugh P. Williamson, M. Inst. C.E., Water Engineer and Manager, Hotham House, Heron Court, Richmond, Surrey, not later than Monday, the 21st January, 1929.

Canvassing in any form will disqualify.

EDWIN M. NEAVE,
Town Clerk.

Town Hall, Richmond, Surrey.
9th January, 1929. 674

Government of Northern IRELAND.

CIVIL ENGINEERING APPOINTMENTS.

APPLICATIONS are INVITED for TEMPORARY POSTS of ASSISTANT CIVIL ENGINEER under the Ministry of Finance. Candidates must have had practical experience in the calculation of channel discharge capacities, hydraulic gradients, water velocities, &c., and the design of weirs, sluices and harbour works generally.

The duration of the appointments will probably be from six to nine months. Salaries will be fixed in accordance with qualifications and experience.

Applications must be made on the prescribed form, which can be obtained from the SECRETARY, Ministry of Finance (Establishment Division), 15, Donegall-square West, Belfast, and must be returned, with copies ONLY of recent testimonials, so as to reach that office not later than Wednesday, 23rd January, 1929. 640

Mersey Docks and Harbour BOARD.

ENGINEERING ASSISTANT TO THE MARINE SURVEYOR AND WATER BAILIFF.

APPLICATIONS are INVITED for APPOINTMENT to the POST of ENGINEERING ASSISTANT to the Marine Surveyor and Water Bailiff.

Candidates must not be over 40 years of age; must hold a Board of Trade First Class Certificate as an Engineer, and have had experience in ship construction and knowledge of motor machinery.

Salary £500 per annum. Applications, with copies of references and particulars of training and experience to be addressed to the undersigned not later than January 31st, 1929.

L. A. P. WARNER,
General Manager and Secretary.

Dock Office, Liverpool.
January 2, 1929. 617

West Midlands Joint Electricity AUTHORITY.

IRONBRIDGE POWER STATION.

APPLICATIONS are INVITED for APPOINTMENT to the following POSITIONS on the staff of the Chief Engineer and Manager to the Authority :—

1. RESIDENT ENGINEER, £600 per annum. The successful candidate will be required to superintend the structural and civil engineering works in connection with the erection of the first section of the Authority's new generating station at Ironbridge, Shropshire, and to reside within easy access of the site. Thorough knowledge of similar work is absolutely essential, including experience in the supervision of piling and reinforced concrete.

2. STRUCTURAL STEEL DRAUGHTSMAN, £6 per week. Applicants must be thoroughly experienced in the design of heavy steel work for power stations or similar structures. The person appointed will be employed at the Authority's offices at Wolverhampton.

Both appointments, which will be subject to one month's notice on either side, are intended to be for the period of the work in connection with the first section of the station.

Applications, giving full particulars as to age, technical qualifications, training and experience, and supported by copies of not more than three recent testimonials, should reach the undersigned not later than Saturday, the 26th January, 1929, in envelopes endorsed with the title of the position desired.

Canvassing, either directly or indirectly, will disqualify the candidate concerned.

H. F. CARPENTER,
Clerk of the Authority.

Central Administrative Offices :
Phœnix Buildings, Dudley-road,
Wolverhampton, 8th January, 1929. 666

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT MANAGER, by Firm specialising in Stonebreaking, Ore Crushing and Roadmaking Machinery, age 30-36, with commercial experience.—Apply by letter only (all applications will be treated in confidence), stating age, experience, and salary required, to H. R. MARSDEN, Ltd., Soho Foundry, Leeds. 665 A

WANTED, Really First-class Experienced SALESMAN, capable of developing great commercial possibilities of proved Hydraulic Transmission Gears and Pumps by well-known maker. Good salary and commission to suitable man.—Apply by letter to Box 47, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 630 A

SITUATIONS OPEN (continued)

CAPABLE YOUNG ENGINEER REQUIRED for important railway to be built in South America. Important company now being formed, willing to make contract giving entire charge. Substantial investment necessary, £1000 to £5000 fully secured. Write fully.—Address, P5347, The Engineer Office. P5347 A

COMMERCIAL ENGINEER, with Experience in Oil Engines and Electrical Equipment, WANTED for our Japan office.—Apply, stating age, experience and salary required, to ATLAS DIESEL CO., Ltd., 35, Surrey-street, London, W.C. 2. 622 A

ENGLISH FIRMS DESIRING First-class Energetic REPRESENTATION in Australia in engineering and associated lines, can procure same with firm of undoubted standing in Sydney. Excellent financial and selling record.—Write in first instance to Z.H. 251, care Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 584 A

ENGINEER REQUIRED for South India. Qualifications, first-class Structural and Mechanical Draughtsman with knowledge of estimating and designing and apprenticeship served with leading constructional firm. First agreement 5 years, passage and outfit allowance paid. Age not exceeding 24.—Reply, with full particulars, to Box 589, c/o Judd's, 47, Gresham-street, E.C. 2. 648 A

INDIA.—REQUIRED, CARRIAGE and WAGON ESTIMATOR DRAUGHTSMAN. Must have good knowledge of design; also experience in large Carriage and Wagon Works. Five years' agreement. Free passage out and home, single man preferred.—Write, with full particulars of experience and copies of testimonials, to Z. C. 224, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 643 A

REPRESENTATIVES WANTED, with Established connections among architects and engineers, able to obtain inquiries for Reinforced Concrete Structures of any description in London and the Home Counties. Remuneration on commission basis.—Apply by letter, giving full particulars, to INDUSTRIAL CONSTRUCTIONS, Ltd., 54, Victoria-street, Westminster, S.W. 1. 661 A

REQUIRED, ENGINEER SALESMAN for Laundry and Steam Kitchen Installations on salary and commission basis.—State age, experience, and references, to Box L. 899, c/o Dawson's, 118, Cannon-street, E.C. 4. 647 A

REQUIRED IMMEDIATELY, ASSISTANT SETTING-OUT ENGINEER for Tunnel Work.—Apply, with particulars of experience, &c., to G. SHELLABEAR and SON, Ltd., Foxhall-lane, Southend-on-Sea. 656 A

SALESMAN-ENGINEER

WANTED for Great Britain by Leading Manufacturer of Heat Economy Instruments. Applicants only considered with experience in Boiler-house Practice, sound theoretical knowledge combustion problems and several years' salesmanship. General knowledge Electrical Engineering essential.—Address, giving full particulars and references, 622, The Engineer Office. 623 A

SMART JUNIOR REQUIRED, Age Between 20 and 24. Must have had previous drawing-office or estimating experience.—Address, 557, The Engineer Office. 557 A

MECHANICAL ENGINEERS.

WANTED, MECHANICAL ENGINEERS for Service in South America. Age about 30, single. Preference for men with experience of Internal Combustion Engines and technical training.—Write, Box M. 389, c/o Willing's, 133, Moorgate, E.C. 2. P5345 A

WORKS MANAGER.—Good ORGANISER REQUIRED, to control Foundry, Machine and Erecting Shops and to cope with rapidly increasing output of old-established firm in South London. Must have first-class knowledge of modern methods. State age, qualifications, salary.—Address, 670, The Engineer Office. 670 A

WANTED, Experienced DRAUGHTSMAN for Bridge and Constructional Steel Work.—W. RICHARDS and SON, Leicester. P5366 A

WANTED, First-class DRAUGHTSMAN DESIGNER in connection with Industrial Electric Heating and Cooking Appliances, in the Midlands. Electrical knowledge not essential.—Address, 625, The Engineer Office. 625 A

ASSISTANT MARINE ENGINE DRAUGHTSMAN WANTED for Far East, with practical experience of High-speed Reciprocating Steam Engines and also with some knowledge of Diesel Engine practice. Single man preferred. State age and full particulars training, experience.—Address, 660, The Engineer Office. 660 A

CENTRIFUGAL PUMP DRAUGHTSMAN, Capable Designer and Accurate Detailer of efficient pumps at competitive prices. Good job for the right man. Experience and previous employers, together with salary required, to be stated. Juniors not eligible.—Address, 608, The Engineer Office. 608 A

CHIEF DRAUGHTSMAN for Tool Room and Relieving Lathes; only one who has real knowledge of these machines is required.

Good conditions and good salary are offered for this job in London.

Address, 544, The Engineer Office. 544 A

DRAUGHTSMAN and ESTIMATOR, Experienced in the design of Heating and Hot Water Work applied to buildings. Good opportunity for suitable man.—Write, stating experience, age and salary required, to HOPE'S HEATING and LIGHTING, Ltd., 59, Berners-street, W. 1. 659 A

DRAUGHTSMAN REQUIRED, Accustomed to Producing scheme drawings and projects for Conveyors and Mechanical Handling Plants. Only men capable and used to working on their own initiative will be considered. State age, wages, and experience.—Address, 597, The Engineer Office. 597 A

DRAUGHTSMAN REQUIRED IMMEDIATELY, near London, accustomed Heavy and Light Plate Work and General Engineering. State age, salary required, with copies of references.—Address, P5363, The Engineer Office. P5363 A

DESIGNERS REQUIRED for Leading Firm of Long-distance Bus and Commercial Vehicle Manufacturers in London District. Only fully qualified and experienced men need apply. Good salary for right men.—Address in confidence, stating age, experience, salary required, to 514, The Engineer Office. 514 A

DRAUGHTSMAN REQUIRED for London Area who has had previous experience in the preparation of workshop details for Structural Steel Work.—Address, stating age, salary expected, and giving outline of previous employment, 657, The Engineer Office. 657 A

DRAUGHTSMAN REQUIRED for Works Department Structural Engineers; must be conversant with details of buildings. State age, experience, salary required.—Address, 626, The Engineer Office. 626 A

DRAUGHTSMAN REQUIRED in the North; Must have had experience in Designing Propellers.—Address, stating age, qualifications, salary required, married or single, to P5339, The Engineer Office. P5339 A

WANTED, TRAVELLER for the Midlands, with good connection, to sell high-class Grinding Wheels. Expenses and commission.—Address, giving full particulars of experience and age, 619, The Engineer Office. 619 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED by London Firm, capable of preparing Plenum Heating and Ventilation Schemes under supervision; also DRAUGHTSMAN, experienced in Dust, Chip and Shaving Removal.—Write, stating experience, salary required, and age, to Box 93, c/o Mather and Crowther, Ltd., 10/13, New Bridge-street, E.C. 4. 549 A

DRAUGHTSMAN REQUIRED with Good Experience of Elevating and Conveying Machinery. State age, qualifications and salary required.—ATLAS WORKS, Pershore. P5368 A

DRAUGHTSMAN, Young, REQUIRED for Firm in London area. Keen, good education, refrigerating experience essential.—Write, stating age, experience and salary required, Box 194, Sells Advertising Offices, Fleet-street, E.C. 4. 633 A

DRAUGHTSMAN WANTED by Well-known Manufacturers of Pumping Machinery. Must have up-to-date experience in design of Reciprocating Pumps and preferably some knowledge of Centrifugal Pumps. Age 25-35. This opening offers wide experience to right man.—Address fully, giving age and salary required, 673, The Engineer Office. 673 A

DRAUGHTSMAN WANTED, with Experience in the design of Heavy Motor Vehicles. State age, experience, and salary required.—Address, 671, The Engineer Office. 671 A

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

A Suggested Iron and Steel Trades Inquiry.

THE text has been published of a letter dated December 31st, 1928, which was sent to the Prime Minister by the General Secretary of the Iron and Steel Trades Confederation. The letter calls attention to the adverse conditions which have prevailed during the past seven years in the iron and steel industry, particularly in the heavy sections. It points out that even neglecting short-time working the Ministry of Labour's returns indicate that for the six years and nine months ending September, 1928, general unemployment has averaged 11½ per cent., unemployment in the coal mining industry 11 per cent., and unemployment in the iron and steel trades over 25 per cent. The tendency to treat the industry as a subject of political controversy is deprecated, and it is urged that a Royal Commission or other competent Committee should be set up to make a full and impartial study of all the facts concerning the present position of the industry, with special reference to the nature of the competition in the home market. The Confederation suggests that among the principal subjects for investigation should be the organisation, equipment and financial policy of the industry, the handicaps, if any, under which it suffers in the matter of its raw materials, and the marketing of its products, competition arising from trade restrictions and lower standards of wages and hours in competing countries, the effect of subsidies in competing countries, and the cost of unemployment. The letter has attracted considerable attention because of the implied willingness to consider the merits of safeguarding as applied to the iron and steel trades, an attitude which is apparently in conflict with the Labour Party's policy of free trade.

The Late Mr. G. Holt Thomas.

BY the death on January 1st of Mr. George Holt Thomas, British aeronautics and British civil aviation in particular loses one of its pioneers. As long ago as 1910 Mr. Holt Thomas took an active part in endeavouring to arouse his fellow-countrymen to the importance of the aeronautical developments then taking place with great rapidity all over the world. In that year, with Paulhan as his pilot, he succeeded in winning the prize of £10,000 offered for a non-stop flight from London to Manchester. Subsequently, he helped to form the Society of British Aircraft Constructors, and the International Air Traffic Association at The Hague. His activities in the production of aeroplanes dated from 1912, in which year he established the Aircraft Manufacturing Company, Ltd., with works at Hendon, for the production of Henry and Maurice Farman machines. On the outbreak of the war his factories became very active. He secured the services of Captain Geoffrey de Havilland as his chief designer, and from thence onwards to the end of hostilities an immense number of D H machines in a variety of types was produced. Following the war, persuaded of the profitable possibilities of the civil side of aviation, he established an allied company, Aircraft Transport and Travel, Ltd., and produced the first British civil passenger machine with which in 1919 he opened the London–Paris air services. This company was eventually absorbed in Imperial Airways, Ltd., which was established under the Government's final subsidisation scheme to take over and amalgamate the three or four rival British companies which were competing for the traffic. In 1920 the controlling interest in the Aircraft Manufacturing Company passed into the hands of B.S.A. and Daimler, Ltd., Mr. Holt Thomas resigned from the board of directors, and soon afterwards the company's activities came to an end. When he gave up his connection with aeronautics and civil aviation, he transferred his interest to agriculture, and particularly to dairying. He was born in 1869, and was the seventh son of Mr. W. L. Thomas, R.I., the founder of the *Graphic*.

Diesel Engine Users Association.

AT the end of December Mr. Percy Still resigned the office of honorary secretary to the Diesel Engine Users Association, a position which he held with conspicuous success for over fifteen years. Mr. G. T. Greenland, who has also given valuable service to the Association in the capacity of assistant secretary, has also given up that office. It is announced that Mr. Still will be succeeded by Engineer-Captain J. Hope Harrison, R.N., and that Mr. C. O. Milton, who for the past two years has acted as joint honorary secretary with Mr. Still, will continue to give the same assistance to Captain Harrison. Mr. F. A. Greene has been elected the honorary treasurer of the Association. The new headquarters of the Association are at 307, Abbey House, Westminster, S.W. 1. In a letter to members and subscribers, Mr. Still makes it known that he is obliged to relinquish his secretarial duties on account of pressing work in other directions. He expresses the hope, however, that the friendships which have been formed in the course of his work for the Association will continue for many years to come. Engineer-Captain Hope Harrison, who in future will devote much of his time to the affairs of the Association, has been a member of its Council for over two years, and has always shown the keenest interest in the Association's objects. He entered the Navy in 1898 from Liverpool University, and was aboard H.M.S. "Rattler" when the gas engine trials were carried out. During the war he took part in various North Sea actions, and organised a training school for anti-submarine warfare. He served in the Engineer-in-Chief's Department at the Admiralty and later on H.M.S. "Thunderer," training ship for cadets. Captain Harrison is a member of the Institution of Naval Architects and the Institute of Marine Engineers, and his marine knowledge should strengthen that side of the Association's activities.

The "Grid" Gas Supply Scheme.

THE National Fuel and Power Committee, over which Lord Melchett presides, was appointed by the President of the Board of Trade in August, 1926, to advise upon questions concerned with the economic use of fuels and their conversion into various forms of energy. In its first report, published last September, the Committee described the gas industry as progressive and efficient on the whole, but characterised the coke oven industry as being below the requisite standard, and as requiring reorganisation as soon as possible. As a step towards such reorganisation, the Committee recommended that the Government should undertake an investigation of the possibilities of distributing coke oven and other gas through a network of mains on the lines of the national electricity grid scheme. It is now announced that the Board of Trade has appointed a committee to undertake the investigation suggested by the National Fuel and Power Committee. This body, to be known apparently as the "Area Gas Supply Committee," will consist of Sir Alexander Walker (chairman), Mr. Thomas Hardie, Dr. C. H. Lander, Mr. W. A. Lee, Mr. M. Mannaberg, Sir R. A. Pease, and Mr. S. Taggwith, Mr. R. J. Moffat, of the Board of Trade, as secretary. It is gathered that the areas for the suggested "grid" distribution of gas to which the Committee will confine its studies will be those proposed by the National Fuel and Power Committee in its first report, namely, the areas lying between Liverpool and the Humber and between Leeds and Birmingham.

Exhaust Turbines for P. and O. Steamships.

IN last week's article reviewing the progress made in steam marine engineering during 1928 we made reference to the decision of the Peninsular and Oriental Steam Navigation Company to fit exhaust steam turbine equipment of the Bauer-Wach type in the P. & O. Branch line steamer "Baradine." Some further particulars of this new proposal can now be given. Altogether, five steamers trading in the Australian, *viâ* the Cape, service of the P. & O. Branch line are to be fitted in the manner indicated. They include the "Ballerat," "Balranald," "Baradine," "Barrabool," and "Bendigo," all of which are ships of 13,000 tons gross and were built and engined by Harland and Wolff, Ltd., in 1921 and 1922. The present machinery comprises twin sets of quadruple-expansion balanced engines with a total designed output of 7000 I.H.P., when supplied with steam at 215 lb. pressure. The steam is raised in two double-ended and two single-ended boilers, each having a diameter of 16ft. 6in. and four furnaces. At present the ships are coal fired, but they are to be converted to oil firing by fitting Todd burners and making new fuel spaces and tanks. The total designed power will be raised to 8000 I.H.P. by fitting exhaust turbines with Beardmore-Vulcan couplings. The work of installing the new machinery will be carried out at Falmouth by R. and H. Green and Silley Weir, Ltd. It is now proceeding on the "Baradine," and it is hoped that all the five ships will be delivered by the middle of the year. A new type of propeller is to be fitted, and an increase of 1 knot in speed, giving 14½ knots mean service speed, is aimed at. This programme of conversion is a noteworthy one, and will enable the steamers dealt with to run at a higher speed with greater economy.

An Air Endurance Record.

ON the morning of Tuesday, January 1st, the American Army monoplane "Question Mark" took off at Los Angeles on an attempt to establish a record air endurance under re-fuelling conditions. The machine, a Fokker, equipped with three 225 H.P. Wright "Whirlwind" engines, carried a crew of five, and was fitted with fuel tanks having a capacity of 500 gallons. Two tender aeroplanes were employed to transmit fuel, oil and food to the machine through a rubber pipe about 35ft. in length. The flight lasted until the afternoon of Monday, January 7th, and extended over a period of 150¾ hours. By the time it finished one engine was out of action and another was failing to develop its full power. The performance establishes an air record in that the longest flight previously achieved by any aeroplane or airship, with or without re-fuelling, was that of the ill-fated French airship "Dixmude," which on one occasion remained in the air for 118 hours. As a demonstration of the practicability of re-fuelling an aeroplane in the air, the performance is noteworthy. It is also of interest as a test of the continuous running abilities of the engines. It is not, however, comparable with an endurance performance carried out without re-fuelling, such as that shortly to be attempted in this country with the Fairey monoplane, for in such a flight the machine has to leave the ground, and for some time afterwards to fly, with a very heavy load of petrol and oil. Further, although the performance demonstrates the practicability of re-fuelling an aeroplane in mid air, it does not demonstrate the advantage such a method of re-fuelling may possess.

The Southern Railway's Programme.

AN expenditure totalling £1,750,000 is involved in the programme of work to be undertaken during 1929 by the Southern Railway. At the Eastleigh, Ashford, Brighton and Lancing works twenty-five express passenger engines, five goods engines, ninety new corridor coaches, including four restaurant cars, fifty passenger luggage vans, and over a thousand trucks of various descriptions will be built. The passenger engines will include five of the "Lord Nelson" class, which will increase the total number in service by the end of the year to fifteen. An entirely new class of three-cylinder passenger engines is to be provided for the severe gradients between London and Hastings and other coastal stations. This class will be known as the "Schools" class, and the first five engines will be called "Eton," "Winchester," "Wellington," "Charterhouse," and "Lancing." The five goods engines are to be of the three-cylinder type. New stations are to be built between Esher and Walton and at Pett's Wood, and alterations and improvements are to be made at seven existing stations. On the Central Section the conversion of the old overhead electric system to the third-rail direct-current system is to be completed by March. When this conversion is effected the railway will own 875 track miles arranged for electrical working. The cost of the total electrification programme now about to be completed will be £11,500,000. The Southern suburban electric system is the largest of its kind in the world. Further extensions are under consideration. At Southampton the £13,000,000 docks extension scheme will be carried a step further by the completion of the dredging of the approach channel and the reclamation of an additional 170 acres of mud land. Other items included in the company's programme cover alterations to the Eastleigh locomotive works and the provision of colour light signalling between London Bridge and New Cross.

The Late Sir Henry Trueman Wood.

UNIVERSAL regret will be felt at the death, in his eighty-fourth year, of Sir Henry Trueman Wood, who was for so long and so intimately connected with the Royal Society of Arts, the welfare of which he did so much to advance. Sir Henry was not, nominally, an engineer, but during his long life he had acquired a very large amount of engineering experience, and he had heard explained and discussed almost every engineering feat or discovery performed or made during a period of very nearly half a century. He was educated at Harrow, and went from there to Clare College, Cambridge, where he obtained a second class in the Classical Tripos in 1868 and was Le Bas University Prizeman in both of the following years. During those two years he was also engaged in coaching. For two years thereafter he was at the Patent Office, acting as examiner. His first association with the "Society for the Encouragement of Arts, Manufactures, and Commerce"—to give it its then full title—took place in 1872, when he was proposed by Sir Walter Besant, who was related to him by marriage, for the position of editor of the Society's *Journal*. Seven years later he became Secretary, in succession to the late Mr. Le Neve Foster, a position which he continued to hold with marked distinction till 1917, thereafter on his retirement becoming successively Treasurer and Chairman of Council. In his position as Secretary of the Society he was brought closely into contact with, and had much to do with the success of, the famous series of Exhibitions held in South Kensington in the 'eighties. He was also largely responsible for the excellent displays made by the British Sections at the Exhibitions in Paris in 1889 and in Chicago in 1893. In fact, he was aptly and correctly described as an "Exhibition Expert." For his labours in this connection he was knighted in 1890. In addition, he was concerned in the formation of the City and Guilds Institute, and was a constant attendant at the meetings of the British Association, acting as Hon. Secretary of the Engineering Section for the seven years 1878 to 1884. An ardent photographer, having practised the art with great success from an early period, he was president of the Royal Photographic Society from 1894 to 1896. Of his literary work we have no further space than to say that in 1910 he published a delightful work entitled "Industrial England in the Middle Ages," which was followed in 1913 by a masterly History of the Society of Arts.

Harbours and Waterways in 1928.

OUR record of port development for the year 1928 indicates some increase in the volume of work which is being done at home and in Dominion and foreign ports. Several large schemes of improvement were brought to completion, and the year witnessed the inception of an increased number of important schemes. Among the former should be noted the dock extensions and improvements at Avonmouth, Birkenhead, Calcutta, and Havre, and the new works begun include the naval base at Singapore. The Bills deposited in the present session of Parliament indicate that practically no new dock construction in home ports is to be undertaken in the near future. It is, however, anticipated that a late Bill, relating to the projected extensions at Grimsby, will be deposited early this year.

The United Kingdom.

Port of London.—The Tilbury and Millwall improvements begun in 1926 by the Port of London Authority are approaching completion. The contractors for the major sections of these works—Sir Robert McAlpine and Sons, Ltd.—have made very rapid progress, and it is expected that both groups of works will be ready for service well before the contract dates. Little now remains to be done at the Tilbury dry dock save the provision of equipment, including a very interesting system of hydraulic bilge-blocks and hauling and centering gear. The latter will travel along the upper altars at the side of the dock, and is designed to keep the stern of a ship on the centre line while it is being hauled into the dock. The dry dock is 110ft. wide at the entrance, and has a depth over the sill of 37ft. 6in. at T.H.W. It is the largest dock in the Port of London and is only 10ft. less wide than the Gladstone dry dock at Liverpool. Although at present only 750ft. long internally, provision has been made for a future lengthening of the dry dock to 1000ft. The new entrance lock at Tilbury, also 110ft. wide, but 1000ft. in length, with 45ft. 6in. depth at T.H.W., is expected to be opened for traffic during the coming summer. The floating landing stage for overseas shipping which is being built near the Tilbury Railway Station is also nearing completion. A portion of the stage is already in use for ferry and other traffic and a contract has been let for the construction of the buildings on the shore platform.

At the West India and Millwall docks, the last of the three communication passages which now link up the West India Dock system with the Millwall Docks was completed last year, and a swing bridge spanning the Millwall Passage is in course of erection. The new entrance lock at Blackwall, which will form the main approach to all the docks in the Isle of Dogs, was begun in August, 1927, and is expected to be opened this year. These works—at Tilbury and Millwall—account for a large part of the further expenditure of £5,000,000 on improvements and extensions which the Port of London Authority decided upon in 1925. We published an illustrated description of the extensions in our issue of July 13th, 1928.

Among other works commenced during the year in the Port of London are a new quay, 1580ft. long, in the Lavender Ponds of the Surrey Commercial Docks for the accommodation of timber vessels, with additional timber storage sheds, and the equipment of quays in the Millwall and West India docks.

The trade of the Port of London during the last completed financial year showed a total tonnage of vessels of over 52¼ millions, an increase of more than 3 millions over the preceding year.

In November the Port of Queenborough, which has had a chequered history since it was first opened in 1876 by the old London, Chatham and Dover Railway Company for the accommodation of the cross-Channel service to Flushing, was reopened for traffic by a commercial company. Situated near the mouth of the Thames where the Medway and the West Swale enter the estuary, it is within the seaward limits of the Port of London, but enjoys immunity from all charges levied by the Port Authority. Queenborough was used intermittently by the Flushing steamers until 1911, since when it had been closed except for naval purposes during the war.

In January the proposals of the Port of London Authority to allow ships carrying petroleum and petroleum spirit in bulk to proceed up the Thames as far as Purfleet were investigated at a Ministry of Transport inquiry. The decision of the Minister, announced in August, was that no alteration in the existing limit of navigation in the river for tank ships should be permitted. This limit was and still is the Mucking Light near Thames Haven, 15 miles below Purfleet. A subject of controversy in the port for many years has thus been settled—at any rate, for some time to come.

The abnormally high tide in the Thames on the night of January 6th–7th resulted in disastrous flooding of considerable areas of low-lying land bordering the river, with consequent loss of life. Records show that the average high-water level in the river at Chelsea increased 8in. between 1890 and 1927, a period which corresponds with the dredging carried out on a large scale in the lower reaches of the river. The maximum flood levels have also steadily increased since 1874, when a tide rose 16ft. 10in. above O.D. at Westminster, considerably higher than any previous record. This height has been exceeded on several occasions since, the highest recorded at Westminster—up to the end of 1927—being 17ft. 6in. in 1881, the same level being reached again in 1882. These high levels were, however, far surpassed by the tidal flood of January 6th–7th, 1928, when 18ft. 3in. above O.D. was reached at London Bridge—equivalent to about 18ft. 5in. at Westminster. It is difficult to estimate how far the increase in average and maximum tidal levels in the upper part of the tidal Thames is accounted for by the deepening of the river, for the problem is complicated by the extensive building of embankments and the rebuilding, with enlarged waterways, of several of the bridges which span the river. The bulk of the dredging was, however, carried out after these works were completed, and there is little doubt that the deepening of the channel has resulted in raising the high-water levels in the Thames, as in other rivers where similar improvements have been effected. One outcome of the January disaster was that a scientific investigation of the question of floods from the river Thames was undertaken by the Liverpool Tidal Institute, whose report was issued in the autumn. This very interesting and valuable document shows that the chief cause of excessive tidal flooding in the river is the building up of a storm surge in the northern part of the North Sea, which, travelling slowly along the coast and increasing in magnitude, happens to enter the mouth of the Thames coincidently with the occurrence of a normal high spring tide. The meteorological conditions required for the creation of a southward travelling surge appear to be a strong westerly wind rising suddenly over the upper part of the North Sea and veering quickly to the north-west and north.

With regard to the future, two steps have already been taken by the authorities mainly concerned with the problem of tidal floods in the Thames. First, a flood prevention branch of the London County Council Engineer's Department has been formed to deal with the inspection and strengthening of river banks and walls and their raising where necessary; and, secondly, a system of high-tide warnings, in which Admiralty and police watchers co-operate, has been established.

The Mersey and the Manchester Ship Canal.—The opening of the Gladstone Dock system at Liverpool, which we recorded in our annual review last year, was followed by the inauguration in July, by Lord Derby, of the new 80ft. river entrance lock at the Alfred Dock, Birkenhead, which has been constructed by the Mersey Docks and Harbour Board at a cost of £1,300,000. This work has been carried out in order to give increased facilities for ships of deep draught engaged in the Eastern trade. These vessels, many of which use the Birkenhead docks, can now be loaded down to the maximum draught which they can carry through the Suez Canal. That is, they leave the Mersey with a draught too great for the Canal but which is reduced sufficiently by the time they arrive at Port Said to pass through the Canal. The new lock provides a depth of water of 40ft. 4in. at mean high-water of spring tides, is 600ft. long, and occupies the site of two smaller locks constructed in 1865.

We referred a year ago to the projected construction by the Mersey Docks and Harbour Board of two experimental groynes or jetties, one on each side of the entrance to the Brunswick Dock, with the object of checking the encroachment of the Pluckington Bank on the fairway and reducing the cost of dredging operations which, in recent years, has amounted to between £60,000 and £80,000 annually. The construction of the jetties was begun in May and, it is reported, has already resulted in an improvement in the condition of the approach channel.

The Dock Board is also engaged on extensions of the oil jetties at the Dingle to meet the increasing trade in oil imports.

Mr. T. M. Newell, the engineer-in-chief to the Mersey Docks and Harbour Board, retired from that position in June, but continues to act as consulting engineer to the Board. He has been succeeded as engineer-in-chief by Mr. T. L. Norfolk.

The building of a dock at Bromborough, on the Cheshire side of the river Mersey, for Messrs. Lever Brothers, begun in 1925, is making slow progress. The river embankment was completed in April, since when the construction of the dock works and the entrance lock has proceeded in the dry. It is expected that the dock will cost upwards of £1,250,000, and it is unlikely to be ready for opening before 1930.

The Manchester Ship Canal Company recently completed the construction of two large five-storey transit sheds (Nos. 7 and 9) at the No. 9 dock. These buildings are of reinforced concrete, and are 450ft. long by 110ft. wide.

The facilities for oil import at Stanlow have been extended, and a new coal-shipping plant at Ellesmere Port has been brought into use. This includes a pair of belt conveyors having an exceptional range of radial movement. The double unit has a maximum capacity of 800 tons per hour. The canal now has a depth of 30ft. from the entrance at Eastham to above Stanlow oil dock. New transit sheds have been provided at Ellesmere Port and the grain discharging plant there has been remodelled.

Bristol Channel and South Wales Ports.—The extension of the Royal Edward Dock at Avonmouth, which had been in the making for four years, was opened by H.R.H. the Prince of Wales on May 23rd. The new eastern arm of the dock, which forms the main part of the new works, has a water area of over fifteen acres and contains 3600 lineal feet of quayage, just about as much as the original dock possessed. The works in the new arm include reinforced concrete wharf structures, transit sheds and grain-handling appliances. Although primarily intended for the grain import trade, the arm is well equipped for general cargo handling. We published a full description of the works in our issues of May 18th and 25th and June 1st last.

The Great Western Railway Company is applying for Parliamentary powers to close the Newport Town Dock, which, if it is to remain in use, must be repaired and remodelled at considerable expense. The dock is said to be surplus to the requirements of the port, but the company's proposals are meeting with some opposition on the part of the Newport traders. The depression in the coal industry has brought about the closing of three coal tips at the Cardiff docks and a like number at Barry. The mole or jetty in the King's Dock at Swansea has been equipped with cranes and a two-storey transit shed, thus providing two additional berths for cargo steamers.

Southampton, Newhaven and Cowes.—A year ago we recorded the beginnings of the great scheme of quay extensions at Southampton, undertaken by the Southern Railway Company, the ultimate cost of which will be about £13,000,000. At that time, however, contracts had been let for only a part of the preliminary dredging and the reclamation of a portion of the area to be occupied by the extensions. During 1928 further contracts for a large part of the main structural works were placed; one, with Charles Brand and Son, for the main drainage and intake culverts across the reclamation; and another, much larger in amount, with Sir R. McAlpine and Sons, for a portion of the quay walls, about 3500ft. in length, and other works. The walls are to be of monolith construction. The monoliths are very similar in size and construction to those recently sunk at Tilbury. The operation of sinking begins at about the level of high water on the edge of the reclaimed area, where the erection of cutting edges was commenced in November. The reclamation bank and the river bed underlying it will be dredged away to a depth of 45ft. at low water on the river face of the quay wall after the completion of the latter. Another contract, for dredging the approach channel and swinging area to a depth of 35ft. below L.W.O.S.T., has also been let. Of over 10,000,000 tons of spoil to be dredged about seven millions will be utilised for further reclamation. The contractor for this work, the James Dredging, Towing and Transport Company, is employing an interesting floating elevator and conveying plant for unloading from barges and spreading the dredged spoil to form the main reclamation bank.

The work of rebuilding the east pier at Newhaven Harbour, which was begun by the Southern Railway Company early in the year, is making good progress. Reinforced concrete, largely in the form of piled work, is being substituted for the old timber structure. The railway company is also rebuilding and remodelling the Medina Wharf at Cowes.

North-East Coast and Humber Ports.—The deep-water quay which the Tyne Improvement Commissioners have built in the river at the Albert Edward Dock at North Shields was opened for traffic in June. We published an illustrated description of this work in our issue of June 15th last. The quay, which is of open construction, consists of a reinforced concrete deck supported partly on reinforced concrete piles and partly on steel cylinders filled with concrete. A portion of the structure where a firm foundation could only be obtained at a great depth is carried on steel cruciform piles, some of which are 90ft. long, encased in steel tubes filled with concrete. The quay, which is 1100ft. long, is constructed in front of the old river wall of the dock and the berth has been dredged at present to 25ft. depth at L.W.O.S.T., but provision is made for further deepening to 30ft. The new quay is intended to be used for overseas passenger traffic, and it has therefore been equipped with a railway station and other passenger accommodation, as well as for goods and fish traffic. The quay railways enable main line passenger trains to run alongside the steamers, and unusually commodious provision is made for road transport traffic. A hydraulic coal hoist, primarily for bunkering purposes, cranes and a large transit shed have also been provided.

The Tyne Improvement Commissioners were in negotiation throughout the year with the London and North-Eastern Railway Company regarding the future development of Jarrow Slake, on the Durham side of the river. It was stated that the Commissioners intended to promote a Bill in the present session of Parliament to secure general powers in respect of the construction of works, and to increase their borrowing powers by £2,200,000, but up to the present no notice has been published.

The new coaling staiths at Blyth, which have been built by the London and North-Eastern Railway in co-operation with the Harbour Commissioners, were brought into use in April, and on the Tees the Conservancy Commissioners have made a partial commencement with their river-deepening, widening, and reclamation scheme.

On the Humber there was much activity throughout the year, both with regard to works carried out and in the preparation of schemes for further development. A covered landing stage for the fish trade at the St. Andrew's Dock, Hull, costing £100,000, is to be 1400ft. long. The first section, 500ft. in length, has already been brought into use. The London and North-Eastern Railway Company also completed in August a new oil jetty at Salt End, which is 1900ft. in length and has a 330ft. T head, with a depth alongside of 30ft. at L.W.O.S.T. The old timber ferry pier at New Holland, on the Lincolnshire shore of the Humber, has been replaced by a steel and concrete structure, begun by the railway company in 1922, and brought into full use early in the year. The original timber structure was opened for traffic in 1849. At Goole, the Aire and Calder Navigation is building new and larger entrance locks for ships of 4000 tons, and the construction of the training walls in the upper Humber is being continued. Among the schemes not yet actually embarked upon, the most important is the project of a new fish dock at Grimsby, in connection with which the Corporation has decided to deposit a late Bill. The dock has been designed by the London and North-Eastern Railway Company, and will be leased to it by the Corporation, which will construct it and raise the money to meet the estimated expenditure of £1,388,000. The Hull Corporation has decided to seek powers for the construction of a new pier to cost £100,000 to deal with the passenger, goods and cattle traffic between Hull and New Holland. Application to Parliament has, however, been deferred for a year.

Other Ports.—The Clyde Trustees have completed the first section of the Shieldhall basins, the quay walls of which are founded for the most part on concrete monoliths, and work is now proceeding on the second section. The depth of water in the new berths is 32ft. at L.W.O.S.T.

The London, Midland and Scottish Railway is engaged on the Fleetwood improvements, which will cost £100,000, and include new slipways, the widening of the fish dock entrance, large additions to the fish market and storage areas, and two new fitting-out berths. The improvement of the harbour at St. Helier, Jersey, at an estimated cost of £250,000, is in hand, and an additional dry dock, 611ft. long and 85ft. wide in the entrance, was opened at Falmouth in September.

Inland Waterways.—Royal Assent was given to the Bills providing for the union of the Grand Junction, Regent, and Warwick canals, which places the entire system of canals linking Birmingham with the river Thames under single control. The combined waterways will, as from January 1st, 1929, be known as the Grand Union Canal. The project of an enlarged waterway from Birmingham to the Severn appears to be dead, and the Worcester and Birmingham Canal has only been saved from stoppage by the raising locally of a guarantee fund of £2000 per annum.

Wireless Fog Signals.—The establishment of the first permanent wireless beacon fog signal in the United Kingdom at Round Island in the Scilly Isles, which we recorded a year ago, has been followed by similar installations at eleven other light stations in the British Isles. In the United States there are now fifty-seven stationary beacon transmitters of the same type in operation at light stations. Several other countries, including Holland, France, Sweden, and Canada, have also established stations. This system appears to be preferred to others by lighthouse authorities, particularly as it is applicable either on shore or on board a light vessel. Both the rotating beam transmitter, as established at Inchkeith in the Firth of Forth in 1922, and the rotating loop system developed by the Royal Air Force are inapplicable for use on a light vessel.

European Ports and Waterways.

The most noteworthy work of port construction brought to completion in France during the year was the first section, about 1200ft. in length, of the Ocean quay at Havre, which has a depth of water in the berths of 48ft. at L.W.O.S.T. This has been constructed, mainly of reinforced concrete piled work, at the western end of the inner tidal harbour. The quay is being extended to a length of about 2000ft. Another quay, with slightly less depth of water, is approaching completion at the eastern end of the harbour near the large dry dock. This quay is being built on foundations put in under compressed air. In spite of the great rise of tide in the port—the mean spring range is 22ft.—the bulk of the recent developments and improvements at Havre has been in the tidal harbour and not in the nature of extensions of the closed docks. The oil import and storage accommodation, which is concentrated on the south side of the tidal harbour, is being developed on a large scale. Cherbourg is making provision for the berthing of the largest class of Transatlantic steamers, and the extension of the breakwater and quays at Marseilles was continued.

Two very large naval dry docks, the construction of which was begun at Toulon as far back as 1911, are now almost ready for use, some subsidiary works only remaining to be completed. The method adopted for the construction of these docks is the same as that employed at Havre, in the case of the large dry dock completed there in 1927, except that two steel caisson foundations placed end to end were used for each dock, instead of the one huge caisson framework employed at Havre. Each dock is 1383ft. long internally, and the entrances are 118ft. wide at sill level, with 40ft. depth of water over the sills. Each dock has two entrances, from the sea and wet dock respectively, and can be subdivided.

The new lock at the entrance to the Amsterdam Ship Canal at Ymuiden is not yet ready for opening, but is nearing completion. The three rolling caissons in the lock are the largest in the world, closing an opening 164ft. wide with a depth of water over the sills of 46ft. at low water of spring tides. The lock has a clear internal length of 1312ft. The caisson gates have now been placed in position.

The construction of the main sea dyke of the Zuider Zee reclamation is making rapid progress, and a commencement has been made with the building of the navigation locks near the Wieringen end of the dyke. The reclaiming of the north-west polder (Wieringen) inside the dyke was begun in 1927, and is expected to be finished about 1932. The reclamation of the three remaining polders will not be commenced until the main sea dyke is completed, probably about 1934.

The deepening and improvement of the old Meuse below Dordrecht, which is expected to be completed this year, will allow sea-going vessels drawing up to 26ft. to reach the town.

Some progress has been made with the construction of the first section of the Alsace lateral canal which the French began towards the end of 1927. This is the portion between Basle and Kembs, and avoids the most important obstacle to navigation in that part of the Rhine—the Istein rapids below Basle. It also comprises a hydro-electric power station at Kembs. It does not appear that the alternative project of river improvement between Switzerland and Strasburg has been altogether disposed of, for German and Swiss interests are still actively pressing the canalisation of the river Rhine itself from Basle down to Strasburg, which, they affirm, can be carried out, and the river made available for traffic, long before the whole length of the Alsace Canal can be completed.

The increasing traffic on the Rhine-Rhone Canal has led to experiments with various forms of mechanical haulage intended to supersede the animal traction which is still mainly employed on the canal. Electric rail-tractors, operated on the trolley system, are to be introduced on an experimental section.

An old project for canalising the river Moselle between Metz and Thionville and constructing a canal for barges of 350 tons capacity to serve the Lorraine iron and steel districts has been revived and is likely to be proceeded with.

The construction of deep-water breakwaters in Italian harbours has been a marked feature of recent years, and the cyclopean method of construction, involving the handling and deposition by floating plant of concrete blocks weighing in some cases over 400 tons, seems to hold the field in preference to other methods of breakwater building in Italy. Among the harbours where such a construction is in progress are Naples, Genoa and Bari. The French have also adopted this system for some recent works.

North and South America.

The scheme of flood-protection works on the Mississippi River, as planned by the U.S. Army Engineers, after the disastrous floods of 1927, provide for a flood of 2,400,000 sec.-feet below Cairo, and 3,000,000 sec.-feet from the mouth of the Red River to the Gulf. The recorded discharge at Vicksburg—between Cairo and the Red River—during the 1927 flood was 2,278,000 sec.-feet. Only one half of the discharge below the Red River will be carried through the main channel, the remainder being diverted through the Atchafalya River. To relieve the channel just below Cairo, a floodway or auxiliary channel will be made, and for the protection of New Orleans a great spillway will provide for the discharge of flood water into Lake Pontchartrain and thence to the Gulf of Mexico. New levees are proposed in certain situations, and the present system of levees will be raised and strengthened where necessary. The cost of the project is estimated at the huge total of £64,000,000, of which £42,000,000 is for levees, spillways and floodways.

The Ohio River improvements, a short account of which appeared in our issue of December 28th last, are nearing completion. Since 1910 over £21,000,000 have been expended on the canalisation and improvement of the river navigation to provide for a minimum depth of 9ft. Fifty weirs, each having a navigation lock, were included in the project, and all of them are now in operation, with the exception of three or four still under construction.

Sanction has been given for the construction of additional water storage works in connection with the Panama Canal, to provide against the possible shortage of water in dry seasons, which, it is said, is foreseen as the result of the rapidly increasing traffic through the canal. The capacity of the Gatun Lake regulator will in a few years' time be insufficient, and the building of a dam at Alhajuela to form an additional storage reservoir is proposed. Proposals for widening the canal and providing another set of locks are also under consideration. Reference to the Panama Canal in any survey of the year 1928 would be incomplete did we not record the death of Major-General George Washington Goethals, who from 1906 until the opening of the canal in 1914 was mainly responsible for the construction, and to whom a large share in the credit for the successful completion of the work is due.

Two or three years' work still remains to be done before the Welland Ship Canal, between lakes Erie and Ontario, will be open to through traffic. The deepening and improvement of the channel of the St. Lawrence below Montreal continues, a depth of 35ft. being aimed at. The Montreal Harbour Commissioners have started the construction of a submerged dam or "sill" in the St. Lawrence near Sorel, about 40 miles below Montreal. This, it is expected, will have the effect of raising the water level in the river above it. The approaching completion of the Welland Canal seems to intensify the demand, both in the United States and in Canada, for an improved waterway between the Great Lakes and the St. Lawrence. Some measure of agreement has already been reached by the Governments of the two countries, but a definite project acceptable to all the parties is not yet in sight. One matter, however, was settled by the announcement in June that the Canadian Government had decided to establish the Lake Ontario terminus of the waterway at Prescott, in Eastern Ontario. Tenders for the first section of these works have been invited.

The abandonment of Port Nelson as the terminal port of the Hudson Bay Railway in favour of Fort Churchill, which was authorised in the autumn of 1927, on the recommendation of Mr. Frederick Palmer, was completed and the works at the new port site are in progress.

Several Canadian ports continue to make large additions to their equipment for the shipment of grain. Montreal now has a total grain storage capacity of over 15 millions of bushels. At Port Arthur an elevator of 7 million bushels capacity was opened in October and in the same month the first elevator to be built on the north shore of Vancouver Harbour was put into service. Among other Canadian ports where new elevator plants were brought into service during the year are Toronto, New Westminster, Victoria (B.C.), and St. John (N.B.).

In South America the extension of the great breakwater at Valparaiso into 187ft. depth of water continues. It will be remembered that there the bold course of founding the breakwater superstructure on a mound almost entirely composed of pumped sand protected by a comparatively thin covering of rubble stone has been adopted by the Chilean engineers responsible for the work. So far the experiment appears to have met with success.

Africa.

The recently completed deep-water harbour at Takoradi on the Gold Coast was formally opened by the Right Hon. J. H. Thomas in April. The work was begun in 1923 and the harbour is the most commodious on the coast, and, indeed, the only deep-water harbour in that part of the world. The two breakwaters are of rubble mound construction, and enclose a water area of about 220 acres. The site is on an open coast, but is free from the trouble of littoral drift. Advantage was taken of a rocky reef extending out from the shore to form the foundation for a large part of the main protecting breakwater, which has a length of nearly 1½ miles. On the inner side of the lee breakwater wharves have been constructed and the low-water depth of water in the harbour over a large part of its area is 33ft. Shortly after the harbour had been formally opened, certain serious defects were discovered in a portion of the wharf construction, and it was considered advisable to postpone the occupation of the berths for traffic until these defects had been made good. This was accomplished in December and the harbour is now in working order. The cost of the undertaking has been about £3,300,000.

The construction of the new breakwaters at Table Bay and Port Elizabeth continues. In the case of the former, an extension of the old rubble mound breakwater is being made in the form of an upright wall block structure, 1500ft. in length. Forty-ton sloping blocks are used founded directly on the sea bed of firm clay. Work is also proceeding on the extension of the basins at Cape Town, the water area of which will be doubled when the works now in hand are completed. Sloping blocks are also being used for the new breakwater at Port Elizabeth.

French harbour development in north and north-west Africa is chiefly confined to the ports of Casablanca in Morocco and Algiers. The trade of the former is growing rapidly, and to meet it the construction of quay walls is being pressed forward. The seaward extension of the Grand Mole is still in progress.

In the building of the new Mustapha breakwater at Algiers, which was begun in 1927, the French engineers have employed the Italian cyclopean block construction, the floating portal crane used for the purpose of handling the blocks being of 450 tons capacity.

At Beira in East Africa a new deep-water wharf is nearing completion and the deepening of the harbour is in progress. The new lighter wharves are already in

use. Sanction has been given to the construction of three further wharf berths at Kilindini (Mombasa).

The East.

The principal item of interest to be recorded in connection with the harbours of the East is the decision of the Admiralty to entrust the contract for the main works of the new naval base at Singapore to the firm of Sir John Jackson, Ltd. This was announced in September. The works to be carried out include deep-water berths, a large dry dock, an oil fuel installation, and dredging. The dry dock is to be 1000ft. in length internally, 130ft. in width at the entrance, with 44ft. of water over the sill at high water. The entrance will be closed by a sliding caisson. The quay walls in the open tidal basin will have a depth of 40ft. below L.W.O.S.T. It will be some years before the dry dock is ready for the use of the Navy, and in the meantime the Admiralty has provided a floating dock, which was constructed by Swan, Hunter and Wigham Richardson, Ltd., and completed in June. The dock consists of seven sections, which were towed out to Singapore in two groups. The larger of the two groups left the Tyne on June 21st and reached its destination on October 13th, after a journey of 8500 miles. The second group of sections reached Singapore some time later. The dock has a length of 855ft., a breadth of 172ft., and requires for its operation a depth of water of about 70ft. Its lifting capacity is 50,000 tons. It is, therefore, not much smaller than the great floating dock at Southampton, which has a total lifting power of 60,000 tons.

In India harbour works are in progress at Vizagapatam, Cochin, and Tuticorin, as well as at the major ports of Calcutta, Karachi, and Madras. The first section of the new King George Dock at Calcutta, which was begun in 1920, was opened by the Viceroy on December 28th. The completion of this work, which has cost over £7,000,000, adds over 190 acres to the water area of the closed docks in the port, and about 25,000 lineal feet to the quayage. The entrance lock, 700ft. by 90ft. internally, with 23ft. depth over the sill at L.W.O.S.T., and about 33ft. at high water neap tides, is smaller than the locks built in recent years in a good many other large ports. This is in consequence of the limitation of the size of ships using the port imposed by the minimum depth of water over the shoals in the river Hugli. Parallel with the lock is a large dry dock, 1190ft. long by 80ft. wide, capable of being subdivided into two docks. It has an entrance from the river as well as from the wet dock, and thus serves the purpose of an emergency entrance to the wet dock. Practically the whole of the quay walls, as well as the lock and dry dock structures, are founded on concrete monoliths sunk to a great depth through very soft alluvial deposits.

At Madras a spur breakwater of rubble stone and random concrete blocks is being constructed seaward from the south-east corner of the harbour. The main object of this spur is to check the northward travel of sand towards the northern entrance. The reinforced concrete jetty in the harbour at Madras has been further extended. This is a work of considerable interest, as it is of very massive construction and is carried on reinforced concrete piles, 25in. square in section, most of which are over 75ft. long. The new deep-water berths at Karachi, which have a low-water depth of 34ft., are still under construction. The quay walls are founded on concrete monoliths, and a portion of the extension is already in use. Tenders have been invited for the new harbour works at Haifa, Palestine, but no contract has yet been placed.

Australasia.

The normal development of the principal ports of Australia and New Zealand continues. A matter which has received a large share of attention in Australia during recent years is the development of the Murray River, the object of which is in the main the irrigation of vast areas of hitherto sterile land. The original scheme, however, included a large expenditure to be devoted to the improvement of river navigation. The enormous cost of the works so far executed, and the statement that the full programme could not be completed for a sum less than £10,000,000 in addition to the expenditure already incurred, has led to the abandonment of a large part of the navigation improvements, the result being that, except on the South Australian portion of the river Murray, navigation will be impracticable. The amount already spent on the works exceeds £5,000,000, and the elimination of the navigation locks above the South Australian boundary is estimated to effect a saving of about £7,000,000 on the revised total estimate of £15,000,000.

Aeronautics in 1928.

No. II.*

WE continue below our account of the work done during the past year by British aeronautical firms and aero-engine manufacturers.

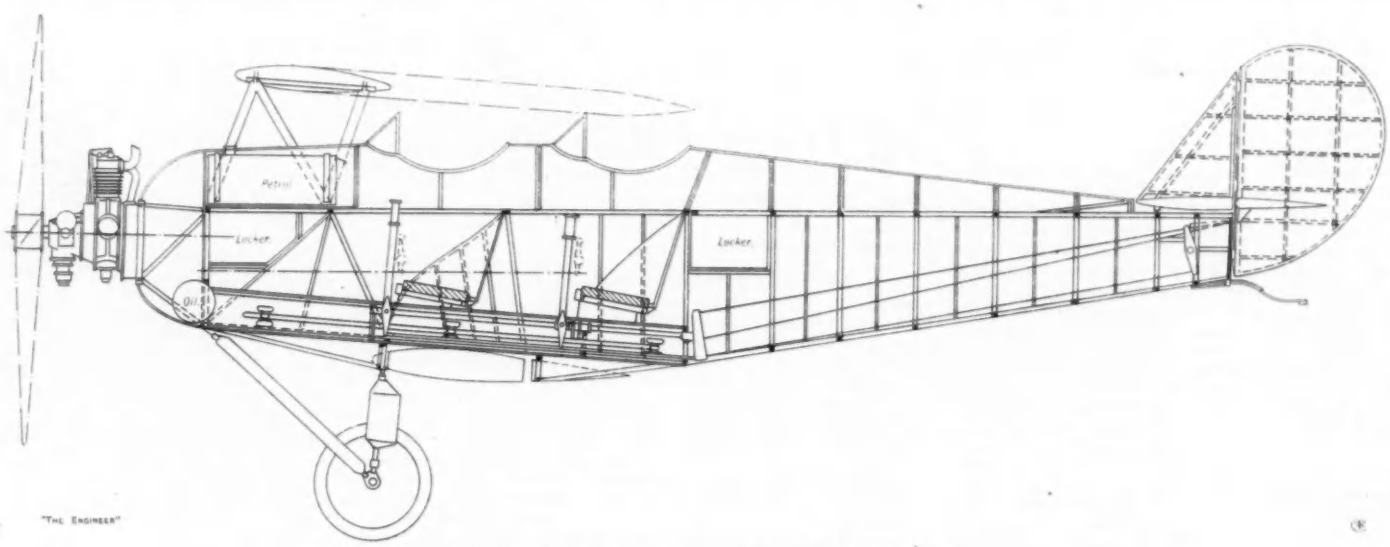
George Parnall and Co.—Apart from the construction of machines still on the Air Ministry's secret list, chief interest in the work of George Parnall and Co., of Bristol, centres in a new method of construction for light aeroplanes, which was developed during the year. The first machine in which the new system was embodied was the Parnall "Imp," of which we reproduce a drawing herewith and a photograph on page 46. This machine has now been put into production with several improvements suggested by the experience gained with the first example. The machine, a two-seater fitted with an Armstrong-Siddeley "Genet" engine, is chiefly novel in the formation and arrangement of its wings. The lower wing is made in one piece and is of the cantilever type. The upper wing is in two parts hinged to a streamline steel tube structure rising from the fuselage and supported from the lower wing by an interplane strut on each side. The upper wings can be removed so as to convert the machine into a low-wing cantilever monoplane. The chief stress-supporting member of the wings is the wing skin, which is made of wood protected by fabric and paint. The internal structure of the wings dispenses with the usual arrangement of two spars and a number of ribs, and replaces them by a number of light stringers to which is attached a series of formers which define the aerofoil section when the skin of spruce veneer is applied to them. The wings are not arranged to be folded, but can readily be dismounted in the course of about two minutes. To facilitate the quick release of the wings, ailerons are fitted to the lower wing only and are arranged to run across the whole span except at the portion lying beneath the fuselage. The fuselage is composed of a spruce framework covered with plywood. The pronounced "sweep-back" of the upper wings and the cut-out portion at their centre provides an exceptionally good view from both cockpits. Dual control is fitted. The "Genet" engine is separated from the front cockpit by a fire-proof bulkhead. It is fed by gravity from a petrol tank placed in the fuselage deck fairing ahead of the front cockpit, and is not, as usual, a part of or attached to the central section of the upper wings. The machine when empty weighs 850 lb. Its top speed is about 102 m.p.h. and its landing speed about 40 m.p.h.

The Gloster Aircraft Company, Ltd.—At the Cheltenham works of the Gloster Aircraft Company, Ltd., the year's activities were characterised by extensive development of new types of machine about which little can be said at present. The principal general direction followed was the development of steel construction with special reference to wings. In this connection it may be noted that the company was entrusted with the design and production of the metal wings for the Westland "Wapiti" machine, to which reference was made in our first article. The spars of these wings were made from four strips of high-tensile steel rolled to a corrugated section and riveted together. The ribs were formed of drawn channel sections of similar material. A special form of very light lattice spar was developed for use in the company's "Goldfinch" all-metal single-seater fighter. This machine, of which a photograph is reproduced on page 46, is fitted with a Bristol "Jupiter" VII. supercharged engine. It has the remarkable speed of 172 m.p.h. at 10,000ft. and of 157 m.p.h. at 20,000ft. Its service ceiling is 26,800ft.

Other work undertaken by the company during the year covered the further development of machines which we have illustrated in previous reviews. The "Gamecock" single-seater fighter was supplied to the Finnish Government in a special form for construction under licence. This machine was fitted with a Gnome-Rhone "Jupiter" engine, and, to meet the Finnish Government's requirements, was made of composite construction. The "Goring" high-speed two-seater bomber was fitted with a Bristol "Jupiter" VIII. geared engine and was developed as a twin-float seaplane. The floats employed are of duralumin treated by the anodic oxidation process. Their addition has been found to affect the performance of the machine very slightly. At all heights the seaplane type has a speed only 3 to 4 m.p.h. less than the landplane type, while the climb to 15,000ft. takes only 5½ minutes longer. The "Grebe" fast-climbing fighting scout was supplied in a widely improved form to the New Zealand Government.

The Gloster Hele-Shaw-Beacham variable-pitch propeller was developed beyond the experimental stage to the point of practical application. This form of variable-pitch gear has now been tested in conjunction with two types of engine the Rolls-Royce "Condor"—by the Air Ministry—and the Bristol "Jupiter"—by the Gloster Company. The "Condor" propeller has now completed over sixty hours' flying with satisfactory results. The "Jupiter" propeller has done ten hours on the bench and six hours in the air with equally good results. A photograph of the complete propeller is reproduced herewith.

Simmonds Aircraft, Ltd.—An excellent indication of the growing vitality of the British aeronautical industry is furnished by the history of Simmonds Aircraft, Ltd., of Weston, Southampton, a new recruit to the ranks of our aeroplane builders. Mr. Simmonds was formerly designer to the Supermarine Aviation Works, Ltd., and was largely responsible, we understand, for the design of the Supermarine "Napier S 5," on which Flight-Lieutenant Webster won the Schneider Trophy race in 1927. In addition to his qualifications as a designer, he is also a pilot of over twelve years' standing, and has recently associated himself keenly with the light aeroplane movement. Deciding to identify himself with the light aeroplane he designed and constructed in his own house the first Simmonds "Spartan" machine. That machine was finished on the day before the King's Cup race of 1928, and in the hands of Flight-Lieutenant Webster completed the 1100 miles course of that race in good style. Following subsequent exhaustive trials, Lieut.-Colonel L. A. Strange, a pilot of extensive experience during the war, associated himself with Mr. Simmonds and the firm, Simmonds Aircraft, Ltd., was established to specialise in the construction of light aeroplanes. The company now has a factory

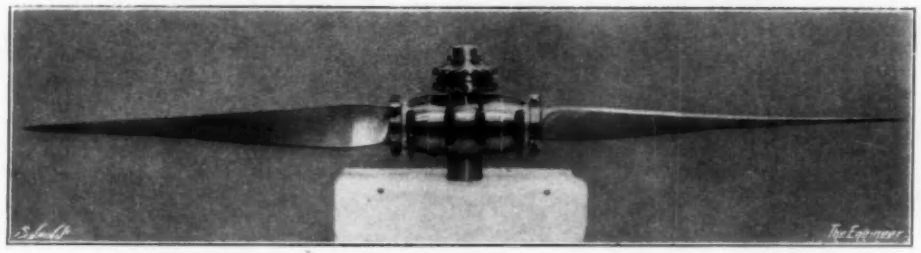


PARNALL "IMP" TWO-SEATER LIGHT AEROPLANE

* No. I. appeared January 4th.

capable of producing 300 machines a year, and is engaged on orders received from all parts of the world.

The Simmonds "Cirrus-Spartan" two-seater light aeroplane, of which we reproduce a photograph herewith, has been designed to provide a large degree of interchangeability among its parts. All four wings are identical and interchangeable, as are the four ailerons. The two elevators are interchangeable with each other and with the rudder. The tail plane consists of a short centre section with two interchangeable fins bolted on by means of fish-plates. All the main flying wires are interchangeable, and finally the left portion of the chassis is interchangeable with the right portion. It is claimed that, as a consequence of this interchangeability, the number of main parts which have to be carried in stock as spares is five, as compared with three or four times that number in other aircraft. This scheme of interchangeability has been carried out, it is maintained, without sacrifice of flying qualities. Indeed, the reports from the flying instructors, which have been submitted to us, express very high opinions concerning the flying qualities of the machine. The fuselage is of wooden construction, with a three-ply covering. The wing structure is also carried out in wood except that the drag bracing is of steel. Steel is employed for the interplane struts. The chassis is in two distinct parts, each consisting of an axle, a radius rod, and a compression member. The tail skid is steerable. A seaplane chassis with duralumin floats can be fitted in replacement of the land chassis. The engine is an A.D.C. "Cirrus" III., developing 95 H.P. at 2100 r.p.m. It is fitted with dual ignition, an impulse starter, and a long exhaust pipe, which acts as a silencer. Twenty gallons of petrol can be carried in a tank on top of the upper centre section of the wings. From this tank the fuel is fed by gravity through "petroflex" piping to the carburetter. The machine has a normal total flying weight of 1300 lb. to 1400 lb., but it is designed to meet the requirements of the full aerobatic certificate of airworthiness at 1680 lb. For special long distance flights it may be loaded up to 2200 lb., giving it a range of nearly 3000 miles. Normally loaded its maximum speed at sea level is 103 m.p.h. Its stalling speed is 40 m.p.h.



GLOSTER-HELE SHAW-BEACHAM VARIABLE-PITCH PROPELLER

SIMMONDS "CIRRUS-SPARTAN" LIGHT AEROPLANE

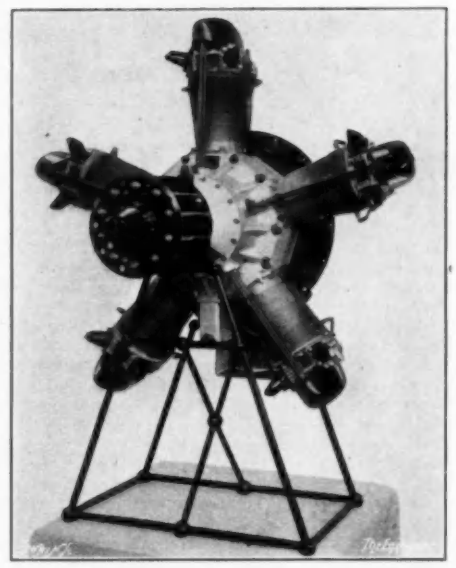
The Bristol Aeroplane Company, Ltd.—Like most other British makers the Bristol Aeroplane Company, Ltd., is now fully prepared to undertake the construction of machines of the all-metal type. Its most recent all-metal machine, concerning which it is at present permissible to say anything, is the "Bulldog" single seater fighter. We illustrated and briefly mentioned this machine in our review a year ago. It may now be stated that the "Bulldog" has been adopted as the standard equipment for certain squadrons of the Royal Air Force. With a total loaded weight of 3150 lb., it has a speed of 180 m.p.h. at 10,000ft., and of 160·5 m.p.h. at 25,000ft. It can climb to the first named height in 6 miniutes, and to the second in 20½ minutes. Its service ceiling is 30,000ft., and its absolute ceiling 31,200ft. The main portion of the structure is made of high tensile steel tubing and built-up steel strip members rolled or drawn to section and riveted together. For a few secondary parts and for certain fairings and doors duralumin is used. The machine when empty weighs 1990 lb. With 70 gallons of petrol, 8 gallons of oil and a military load of 528 lb., its total loaded weight is 3125 lb. The military load consists of the pilot, parachute, two Vickers guns, 1200 rounds of ammunition, C.C. interrupter gear for both guns, gun sights, oxygen apparatus, electrical equipment, instruments, and wireless apparatus. In addition, a bomb rack may be mounted towards the root of the lower port wing.

On the engine side it is of much interest to learn that although the Bristol "Jupiter" engine is now being manufactured under licence in France, Germany, the United States, Czecho-Slovakia, Belgium, Switzerland, Hungary, Jugo-Slavia, Italy, Spain, Portugal, and Japan, the factory at Bristol, even by running day and night shifts, is finding it impossible to deal with the orders received for the engine from all over the world. As a consequence of this activity, the company has had to make repeated additions to the buildings and plant of its engine department. The "Jupiter" engine is now being produced in a series of different models, including geared, ungeared, and supercharged designs. Some details of these engines were given in our review a year ago. A new design has since been added to the series, namely the "Jupiter" XI. This is a geared engine with a 2 to 1 ratio. Its compression ratio is 5 to 1, and at 4000ft. its rated output at the normal engine speed of 2000 r.p.m. is 460 B.H.P. The speed may be raised to 2200 r.p.m. with a resultant increase of the output to 500 B.H.P. The series VIII. engine, also one of the geared designs, has, we notice, had its compression ratio reduced from 6·3 to 5·8.

A new design of air-cooled engine, the "Titan," was recently placed on the market by the company. This engine, illustrated herewith, has five cylinders, as compared with the "Jupiter's" nine. It is intended primarily for use in commercial or service instructional machines. Its major components are interchangeable with those of the "Jupiter." In particular, the cylinders and pistons are identical with those of the older and larger engine. It is, however, impossible to employ the "Jupiter" spiral induction system on a five-cylinder engine, and accordingly an engine-driven mixture distributor fan is used instead. The engine has a compression ratio of 5 to 1, and a rated power of 200 B.H.P. at the normal speed of 1700 r.p.m. It weighs 500 lb. in the dry state. For service purposes the compression ratio is increased to 5·3 to 1, with a resulting increase of the output at normal speed to 220 B.H.P.

The Armstrong Siddeley Development Company.—The two firms known as Sir W. G. Armstrong, Whitworth Aircraft, Ltd., and Armstrong Siddeley Motors, Ltd., are now owned by an organisation called the Armstrong Siddeley Development Company. That organisation during the year also acquired the ownership of A. V. Roe and Co., Ltd., of Manchester and Hamble. With three aircraft factories and another factory producing aero-engines and motor cars, the Development Company claims to be the largest organisation in this country manufacturing aeroplanes and aero-engines.

For the past ten years Armstrong Whitworth Aircraft, Ltd., has been steadily engaged in the design and production of aeroplanes in which the structural members are made of steel. The first type of steel aeroplane produced in quantity by the firm was the "Siskin" single-seater fighter, which made its appearance six years or so ago, and which we have illustrated in previous reviews. That design, considerably improved, is now being made under licence by four other aircraft manufacturers. The firm's latest design is the "A W 14" high-performance, single-seater fighter. This machine—illustrated on page 46—is a development of the "Siskin" design. It is driven by an Armstrong Siddeley "Jaguar" supercharged engine, and is fitted with a Fairey Reed metal airscrew. The "spinner" of the airscrew, forming as it were a continuation of the stream-line form of the fuselage, is composed of a metal nose and a plywood base. Provision is made for cooling the lubricating oil and for the attachment of a Rae gas starter. The flying organs are composed of six main units, namely, the two top planes, the two lower planes, the tail plane, and the rudder. All these units can be quickly detached for storage or transport. The principal general characteristics of the machine are the good view it affords ahead, aside, and over the planes, its manœuvrability, its high ceiling and its high speed at altitude. With a full load, it can reach a speed of 160 m.p.h. at 15,000ft. Its ceiling is about 30,000ft., and its landing speed about 60 m.p.h. In addition to the full service load, it can carry 50 gallons of petrol and 5 gallons of oil.

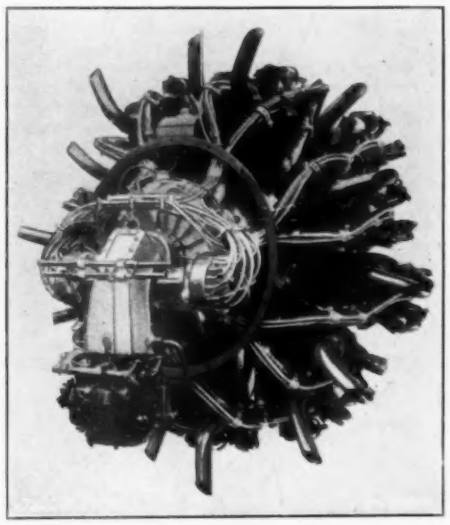


BRISTOL "TITAN" 200 B.H.P. ENGINE

The Armstrong Whitworth method of producing spars, ribs, and other components from steel strip consists of the employment of rolling and drawing machines for the production of the requisite sections from the material in the soft state. After formation, the sections are hardened and tempered electrically. Following assembly, the completed structure is cleaned and dried, and is then dipped as a whole in a tank containing an elastic enamel. It is then stoved and re-dipped. The fuselages are built up of high-tensile steel tubing, fastened by mechanical joints, which avoid the use of welding.

Five different types of aero-engine are now produced by Armstrong-Siddeley Motors, Ltd., namely, the "Leopard" and "Jaguar," both with fourteen cylinders and of 750 and 440 normal horse-power respectively, the "Lynx" with seven cylinders and a horse-power of 225, and the "Mongoose" and "Genet" with five cylinders and of 140 and 88 normal horse-power. All these engines are of the static radial air-cooled type. In accordance with modern tendencies, the "Lynx," "Jaguar" and "Leopard" engines can now be fitted with epicyclic reduction gearing, the object being to improve the propeller efficiency and thereby to secure a gain in the level flying speed and a still more noticeable gain in the rate of climbing. In the case of the "Jaguar" engine the reduction gearing reduces the air screw speed in the ratio of 0·657 to 1 relatively to the crank shaft speed. The gearing adds about 60 lb. to the weight of the engine and 3¾in. to its length. A supercharged "Jaguar" engine is illustrated herewith. The supercharger unit is attached to the rear face of the engine body and delivers carburetted mixture to the cylinders through seven forked induction pipes. The intake side of the unit is in communication with the carburetter through an oil-jacketed induction elbow. The unit contains a ten-bladed fan-type rotor driven at 12·9 times the engine speed through gearing from the rear end of the crank shaft. Centrifugal clutches are embodied in the gear drive to prevent damage to the blower and to equalise the load when the engine is being accelerated or decelerated. The object of the unit is to maintain a uniform pressure of 14·2 lb. in the induction pipe at all altitudes

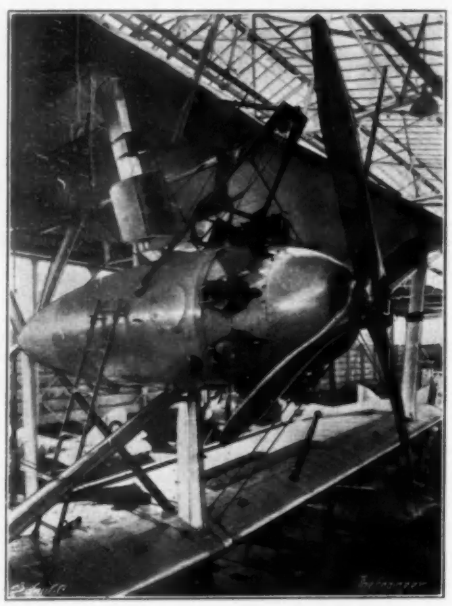
irrespective of the atmospheric pressure. There is naturally an upper limit of altitude at which it becomes impossible for this pressure to be maintained. Near the ground level the operation of the unit would, if not controlled, seriously overstress the engine. A throttle is therefore provided which the pilot controls as the machine rises. The induction pipe pressure is



SUPERCHARGED "JAGUAR" ENGINE

indicated to him on a "boost gauge" on his dashboard.

Short Brothers, Ltd.—In our issue of January 7th, 1927, we published a drawing of the "Calcutta" commercial flying boat, on the design and construction of which Short Brothers, Ltd., of Rochester, were then engaged. The two machines of that design which the Air Ministry had ordered were completed during the past year, and after undergoing their trials at Felixstowe were handed over to Imperial Airways for operation. One of them was placed temporarily on the Southampton-Guernsey service in order to obtain data and experience preparatory to its employment on the Mediterranean service which is to be begun this year. The second machine was likewise employed for a short time on the Liverpool-Belfast service. The machines on trial exceeded

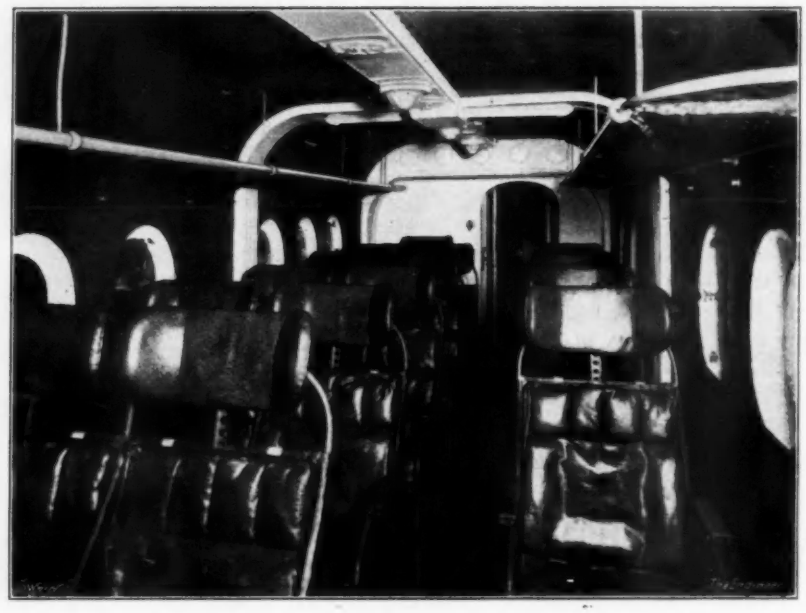


"CALCUTTA" FLYING BOAT ENGINE

their predicted performance and were particularly noticeable by reason of their general stability. One of them was fitted as shown in the engraving on page 46 with Handley Page automatic slots. A third "Calcutta" machine is now being built for Imperial Airways to operate in conjunction with the first two. The certificate of airworthiness weight of the "Calcutta" has been increased to 22,500 lb., making the ratio of the available load to the all-up weight 43 per cent., a remarkable figure for a machine of this type.

As the "Calcutta" will provide an important link in the England-India aeroplane service which is to be established this year by Imperial Airways, some further details concerning the design may prove interesting. The machine is driven by three "Jupiter" engines mounted in line in separate nacelles and can maintain flight with any one of the engines out of action. In the central nacelle a Bristol engine starter is installed and is connected up to all three engines. The starting engine is also arranged to drive a mechanical bilge pump and a dynamo for the lighting and wireless services when the main engines are not running. Petrol is carried in two tanks in the upper plane, the feed from which is entirely effected by gravity. The lubricating oil is carried in tanks in the nacelles and is circulated through external oil coolers. A view of one of the engine nacelles is reproduced herewith. In this engraving there is shown in position a removable gantry whereby the engines may be removed and refitted while the machine is afloat.

With the exception of the covering surfaces the machine is entirely of metal construction, chiefly



PASSENGERS' CABIN, "CALCUTTA" FLYING BOAT

of duralumin with stainless steel fittings. Special attention has been given to the water performance of the hull, the lines of which were determined after considerable research by the firm in its own testing tank. The pilots sit side by side in a cockpit near the bow. The starboard control column is made detachable in order that the assistant pilot may pass forward for mooring purposes to a hinged hatch at the extreme bow. The assistant pilot is also the navigator and wireless operator, and immediately aft of the pilots' cockpit is provided with a chart and wireless room shut off from the cockpit by a roller blind. The main cabin for the passengers, of which an illustration is given herewith, measures 17ft. in length, 6ft. 6in. in width, and 6ft. 3in. in height. Each seat is fitted with a collapsible table and, as part of its upholstery, with a cushion which in emergency can be used as a lifebelt. The ventilation of the cabin is effected by means of a fresh air duct running along the roof of the cabin. This duct also carries the lighting cables. Beyond the passengers' cabin there is a steward's buffet fitted with an ice chest and oil cookers and also in the rear there is a toilet compartment. The passengers reach the cabin through a hatch at the forward end, which is so arranged that they may step direct from the flying boat to the quay at which it is moored. A separate hatch is provided aft for loading the luggage. If the machine is required to carry mails or other freight the passengers' seats are removed from the cabin. A Marconi A.D.8 receiving and transmitting wireless telegraphy and telephony equipment is provided, giving a normal transmitting range for telegraphy up to 400 miles and for telephony up to 250 miles. An emergency aerial can be rigged up on a telescopic mast attached to the upper plane for use when the machine is moored in harbour or after it has made a forced descent.

Several interesting designs of new machines were begun by Messrs. Short during the year. One such machine is a three-engined enclosed-cabin monoplane seaplane, fitted with the same engines and approximately of the same weight as the Calcutta flying boat. This machine is being built for the Air Ministry, and will probably be used for commercial work on the Nile. It is being constructed in order to explore the possibilities of float seaplanes of large size, and to compare them with those of a modern flying boat. It will have an overall span of 107ft., an overall length of 69ft. 8in., and an overall height of 19ft. 6in. Its weight empty will be about 12,700 lb., and its available load about 8000 lb. It will provide accommodation for a crew of three and seventeen passengers. A second commercial machine on which the firm is engaged is a single-engined twin-float seaplane, which may be converted to a land plane. It will be driven by a geared "Jupiter" engine, and will accommodate a pilot and six passengers. Like the first new commercial machine now in course of construction, it will be of the monoplane type, and will be built entirely of metal.

The Fairey Aviation Company, Ltd.—For some time past it has been known that the Air Ministry had decided to make an attempt on the world's long distance aeroplane record, and that for that purpose had placed an order for a special type of monoplane with the Fairey Aviation Company, Ltd. of Hayes, Middlesex. That machine was completed during the year and is now flying. It is possible that before these lines appear in print particulars of the design of this very interesting machine will be available for publication, but up to the last day of the old year it remained on the official secret list. The company also began the construction of several other new types of aircraft, concerning which nothing may be said at present.

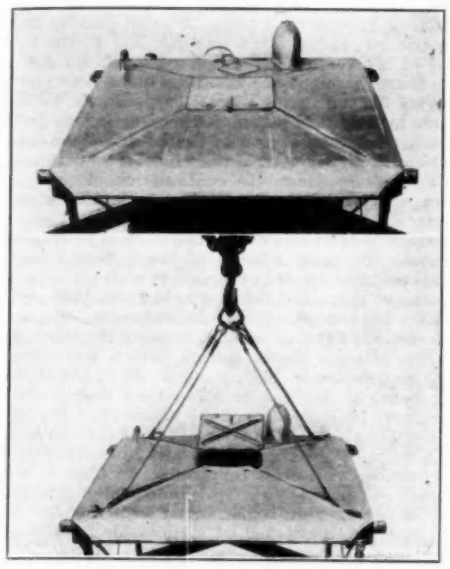
Generally speaking, the year witnessed the complete change over of the Fairey works to metal construction on a full production basis. A year ago we illustrated the "Fairey" III. F general service machine, which at that time was being made with a metal fuselage and a wooden wing structure. This design has now been converted to a construction entirely of metal, and in that form large numbers were made

FAIREY III F—WINGS FOLDED

during the year for the Royal Air Force, for the Argentine, Chile, New Zealand, the Irish Free State, and other countries. The Fairey "Fox" high performance light-day bomber—illustrated in our issue of January 8th, 1926—had its capabilities still farther increased by the replacement of the "Felix" D 12 engine—a British version of the American "Curtiss" D 12 engine—by a new type of Rolls-Royce engine of higher power. As a day bomber the "Fox" impressed its merits on all who saw the annual air manœuvres over London during the summer. Repeatedly groups of Foxes broke through the aerial and ground defences, and with their high turn of speed generally managed to escape when intercepted by the defence's single-seater fighters. In addition to machines of the III. F and "Fox" types produc-

tion was also continued of the "Flycatcher," a single-seater ship's fighter, for the Fleet Air Arm, which we described in our issue of January 4th, 1924.

In our review of a year ago it was not permissible to publish more than a few general particulars of the "Fairey" III. F machine. Since that date official restrictions have been removed sufficiently to enable us to say something about the details of the design. The III. F is a general purpose machine in the fullest sense. From the military point of view, it is available as a two-seater fighter, bomber or reconnaissance machine. It is also available as a three-seater for the same duties. As a three-seater



FAIREY III F LIFTING SLING

it is in use by the Fleet Air Arm for naval reconnaissance work. It can be readily converted to an ambulance, passenger or long distance machine. In all these military or civil forms it can be employed either with a land or a float type of under-carriage. Finally, its power equipment is open to a range of choice. It has been produced with Napier "Lion," Rolls-Royce and Lorraine water-cooled engines, and with a Bristol "Jupiter" air-cooled engine.

In all its forms the machine is provided with folding wings. In the folded condition—see the accompanying engraving—the wings are rigidly locked to the tail plane. A squadron of nine III. F machines with their wings extended would require for their housing

FAIREY III F BOMBER'S COCKPIT

about 14,500 square feet, but with the wings folded the space required is reduced to 5650 square feet. Another standard feature is the concealed sling housed in the centre section of the top plane. As illustrated herewith the sling is contained in four channels covered by the rip fasteners which are now in popular use for a very wide variety of purposes. This sling is particularly useful when the machine, as a sea-plane, has to be hoisted on board a ship from the water. It is also of service as a means of lifting the machine by shear legs for the purpose of changing the undercarriage.

The machine is constructed with sufficient strength to withstand its being launched from a catapult from a warship or ocean liner. For this purpose catapulting points are provided in the structure of the fuselage. If a water-cooled engine is fitted the radiator is placed behind and below the engine and is made retractable so that the amount of radiator surface exposed to the air stream can be varied to suit the flying conditions. The movement of the radiator is controlled from a crank handle in the pilot's cockpit and its amount is shown on a dial indicator. The weight of the radiator is taken by a spring compensating device which, in conjunction with ball bearings at the controls, makes the movement light. Two telescopic pipes on top of the radiator are provided for the inlet and outlet of the water and are made tight by means of adjustable glands. The radiator is served by a header tank situated in the top centre plane.

The engine is supplied with fuel by an engine-driven petrol pump. On its way to the carburetters the fuel passes through a hand pump which can be brought instantly into use by the pilot should the engine pump fail to act. In some systems in which a gravity tank is provided to replace the mechanical pump supply in emergency the changing over of one or more cocks on the system involves a delay of a few seconds which may result in serious consequences if the failure occurs just after the machine has taken off. In the Fairey system the fuel at all times flows through the hand pump and the hand feed can be brought instantly into use without the turning of a single cock. The normal fuel capacity is 124 gallons, which is sufficient for a flight of about 700 miles at cruising speed. The range can, however, be increased to 1450 miles by means of additional tanks attached in place of the bombs to the racks beneath the wings.

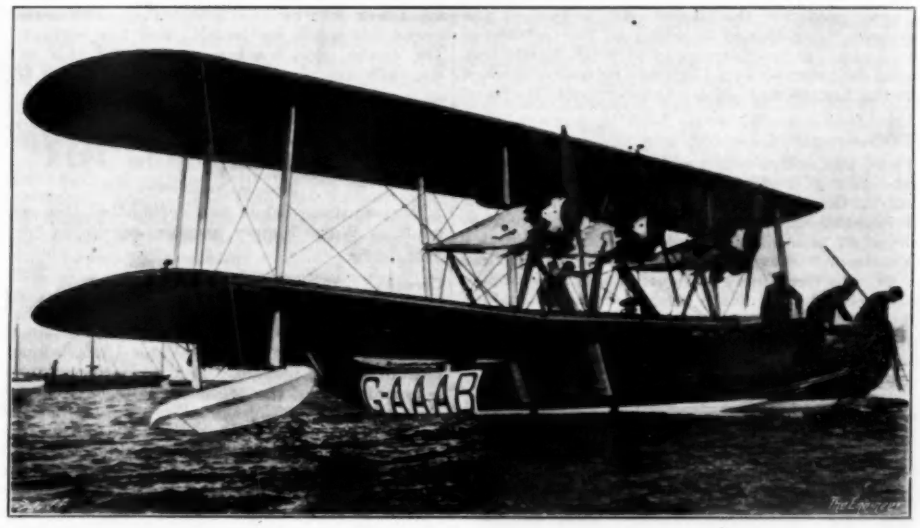
The pilot's cockpit is provided with a very complete set of instruments and controls. The seat can be raised or lowered through a range of 4in. while the pilot is sitting on it and can be set low enough to accommodate a seat-type parachute. Beneath the seat three oxygen cylinders can be stowed. In the three-seater model a wireless operator is stationed between the pilot and the after gunner. In the two-seater design the two cockpits are brought very close together so as to facilitate communication between the pilot and the gunner. A view of the interior of the rear cockpit with the occupant in position at the bombing trap door is reproduced herewith. Below the trap door in the fuselage fairing there is a sliding panel which can be slid back when the door is opened. This panel, when the trap door is closed, maintains the fairing of the fuselage and assists the performance of the machine.

The armament of the machine consists of a belt-feed gun firing forward operated by the pilot and a drum-feed gun under the charge of the after gunner. Under the main planes, racks are provided for various bomb loads, such as two 230 lb. bombs and four sighter bombs. Separate release controls are provided for the pilot and the gunner.

The Supermarine Aviation Works, Ltd.—At the Woolston and Hythe (Southampton) establishments of the Supermarine Aviation Works, Ltd.—now associated with Vickers (Aviation), Ltd.—the year as usual covered a considerable amount of experiment, research, design and construction relating to marine aircraft and flying boats. It is not permissible to give details of the work done, but it is possible that some of its results may be seen at the International Aero Exhibition, which is to be held at Olympia, London, in July. A machine to which reference may be made is the Supermarine "Solent" flying boat, of which we give an illustration herewith. This machine is driven by three Armstrong-Siddeley "Jaguar" engines, and is the first flying boat fitted with air-cooled engines to be built by the firm. Our engraving illustrates the machine fitted as a civil passenger-carrying "flying yacht." It has also been adapted to service purposes as a torpedo carrier, in which form it is stated to be the first torpedo carrying flying boat to be built. As a "flying yacht," the machine during September was used by the Hon. A. E. Guinness for a fortnight's flying holiday over the lakes and along the west coast of Ireland. On this trip, which was completely successful in every way, the machine carried three passengers and a crew of three. It is a striking fact that it was the first aircraft of any kind seen by the inhabitants of many of the remote districts over which the flight extended.

Three metal-constructed "Southampton" flying boats were built and delivered to the order of the Air Ministry for use in the Persian Gulf. One of these machines was fitted with Bristol "Jupiter" air-cooled engines. The machines are of the same type as the four used on the R.A.F. Far East Cruise, which during the year completed the 25,000-mile flight of its programme. A modified and improved type of "Southampton" flying boat is now being built. A large three-engined monoplane "flying yacht" is being completed for a private owner. A twin-engined amphibian flying boat with air-cooled engines is undergoing trials. Work is proceeding on an "S6" racing machine for the Schneider Trophy race, which is to take place at Cowes in September. This machine will be of metal construction. During the year the Supermarine "Napier" S5 machine, with which the trophy was won for this country in 1927, created a speed record by flying at 319 m.p.h. Unfortunately, the margin between this speed and the previous speed record established by Com. de Bernardi on an Italian seaplane, was not sufficient to secure its acceptance as a world's record.

A.D.C. Aircraft, Ltd.—A new type of "Cirrus"



SUPERMARINE "SOLENT" FLYING YACHT

engine was introduced by A.D.C. Aircraft, Ltd. Like the earlier types, the new Mark III. engine has four air-cooled cylinders arranged in line, and is designed to meet the requirements of light aircraft. The Mark I. type was rated at 27/60 H.P., and the Mark II. at 30/80 H.P. The rated horse-power of the Mark III. is 85/95. The new engine has been produced to suit light aircraft to be operated at high altitudes, for light seaplanes and to obtain an increased taking off speed and an improved rate of climb. It retains the characteristics and general features of the earlier designs, but possesses an improved cooling efficiency, a new design of cylinder head, larger valves and improved valve gear. The cylinders are of the same size—110 by 130 mm.—and the weight is the same—280 lb.—as in the Mark II. engine. The compression ratio has, however, been increased from 4·9 to 5·1 to 1. The ratio can be raised if required to 5·4 to 1 by removing a steel ring from beneath the base of each cylinder.

As evidence of the growth of the light aeroplane movement, it is of interest to learn that during one week in November, 1928, the company received orders for over 150 "Cirrus" engines. Arrangements have now been made for the manufacture of the engines in the United States and in Japan. An interesting application of a Cirrus II. engine to an "auto-giro" or windmill plane is now being tested. During the year Cirrus-engined machines executed several remarkable flights, notably Mr. Hinkler's flight of 12,000 miles in 15½ consecutive days from England to Australia in an Avro Avian-Cirrus II. light aeroplane, and Lieutenant Bentley's double journey from England to South Africa and back—a total distance of 25,000 miles—on a de Havilland "Moth" light aeroplane. It is a noteworthy fact that the engine used by Mr. Hinkler on his flight to Australia was the fifth issued from the makers' shops, and had previously been employed by the same pilot in various races and long-distance flights, including a non-stop flight of 1200 miles in 10 hours 45 minutes from London to Riga.

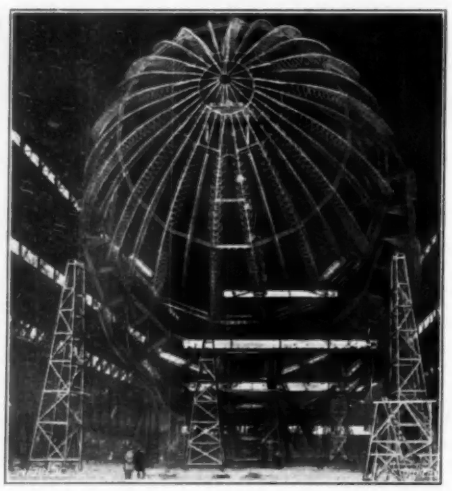
H. G. Hawker Engineering Company, Ltd.—At the

Kingston-on-Thames works of the H. G. Hawker Engineering Company, Ltd., there was considerable activity on the production of the "Horsley" coastal defence torpedo-carrying or bombing machine. We illustrated this machine a year ago. It carries a 21in. torpedo, weighing over 2000 lb.—or an equivalent weight of bombs—and has an endurance of eight hours, equivalent to a range of about 900 miles. A single-seater fighter, the "Hawfinch," of metal construction, was the outstanding item in the firm's list of new productions apart from the machines on the secret list. This machine is of steel construction throughout, except for the ribs of the wings, which are of aluminium. The Hawker system of metal construction is of a special type concerning which we hope to be able to say more on some future occasion. Ease of production and simplicity of design and maintenance are the features aimed at in it.

A. V. Roe and Co., Ltd.—Farther development of the "Avian" light aeroplane was a marked feature of the work done during the year by A. V. Roe and Co., Ltd., of Manchester. The chief modification made was in connection with the undercarriage. While the wide—6ft.—wheel track of the earlier pattern has been retained, the resilience and length of travel of the shock-absorbing components has been increased in the new design of undercarriage, and the method of its attachment to the fuselage has been improved. An interesting event was the acquisition by the firm of a licence to manufacture the "Fokker" F VII. three-engined commercial monoplane, and to sell it in Great Britain and most of the Dominions. In connection with the production of military training aircraft, the firm developed a new type of machine known as the Avro "Gosport," fitted with a 130 H.P. Armstrong-Siddeley "Mongoose" engine. The Avro "Lynx" has for some years been the standard training machine used by the Royal Air Force. The "Gosport" is designed to retain all the features of the "Lynx," to be cheaper and to weigh 300 lb. less. During the year the Avro Company became associated with the Armstrong-Siddeley Development Company.

Airships.

There was undoubtedly a great revival of interest in the airship during the year, particularly in this country, Germany, the United States, and Italy. The experiences of Italy were unfortunate, for they culminated in a disaster to General Nobile's airship on an attempt to explore the north polar regions from the air. In Germany great enthusiasm was aroused by the completion of the airship "Graf Zeppelin" and its flight from Friedrichshafen to the United States and back again. Technically, that accomplishment was interesting because of the fact that the



AIRSHIP R 101—VIEW OF NOSE END

engines of the ship were driven throughout the double voyage by fuel gas in complete replacement of petrol or other liquid fuel. The vessel, according to her designer and navigator, Dr. Eckener, of the Zeppelin Company, was, however, proved to be a failure. The dimensions of the shed in which it was built imposed restrictions on its diameter and length and on the disposition of the engines. For the purpose of transoceanic flights, Dr. Eckener states that airships should be shorter and of greater diameter than the "Graf Zeppelin," and should have greater engine power and a higher speed. Already Dr. Eckener, with the support of public subscriptions, is planning the construction of a new airship with which he hopes to make trips to America and possibly to fly to the North Pole. In the United States a contract was placed by the Government for the construction of two airships, each of 6½ million cubic feet capacity. Particulars as to the design of these vessels are not yet either full or authoritative, but it is gathered that the airships will possess several features of an unusual kind, including propellers mounted so as to be capable of being set with their shafts vertical in order to increase the lift when occasion requires.

In this country interest was concentrated on the construction of the five million cubic foot airships "R 100" and "R 101." Neither of these vessels is yet ready for trial, but it has been stated that the Airship Guarantee Company's vessel, the "R 100," now being completed at Howden, Yorkshire, will be ready to take the air in the spring. Concerning the progress made with the construction of the "R 101" since we published a description of the work on it in our issue of August 31st, 1928, we learn officially that the central body, consisting of ten transverse frames and the intervening longitudinal girders, has now been completely erected, and the work of putting on its outer cover has been begun. Forward of this central portion the hull structure has been completed and joined up. Two of the three transverse frames for the tail portion are now being erected in the Cardington shed. The extreme end of the tail, a light piece 60ft. long, built up on the conventional Zeppelin principle, has been completed.

In one of the accompanying engravings we reproduce an official copyright photograph showing the nose end of the vessel under construction in the shed at Cardington.

Progress was also made during the year with the ground organisation for use in conjunction with the two British airships. At Cardington a second shed was made available by the transference and enlargement of one of the sheds at Pulham. The first shed and mooring tower have been completed for some time. The Ismailia, Egypt, mooring tower and airship base are also ready for operations. At Karachi, India, a shed even larger than those at Cardington was begun some time ago, and is now almost completed. The Karachi mooring tower was begun in September, 1928, and is now almost ready for operations. In Canada the air base at St. Hubert, Montreal, will be finished early this year. At that base a mooring tower will be available. The structure of the tower was made in Canada, and has been erected. The tower head machinery made in this country was fully described in our issue of December 28th.

Water Supply in 1928.

No. II. (*conclusion*).*

WE continue below our account of the progress made in Water Supply Engineering during the past year.

Coventry.

By the Coventry Corporation Act, 1928, the Corporation was empowered to carry out certain works for the development of the Water Undertaking at a cost of some £300,000. The works include (*a*) the augmentation of the present resources by new wells and pumping stations at Watery-lane, Brownshill Green and Mount Nod; (*b*) the construction of additional storage reservoirs, in the Low Level Zone, (*c*) increasing the capacity of the reservoir at Coundon by 9,000,000 gallons; (*d*) the construction, in the Middle Level Zone, of a new reservoir on Meriden Hill, with a capacity of 10,000,000 gallons, and another at Corley, with a capacity of 800,000 gallons; (*e*) the construction of water towers, each of 200,000 gallon capacity, one in the Middle Level Zone and one in the High Level; (*f*) the modernisation of the pumping plant at the Spon End, Whitley and Watery-lane Stations; (*g*) the laying of 6 miles of trunk 27in. to 18in. mains, 10 miles of intercommunicating mains, 12in. to 9in., and other ancillary works.

South Essex.

The South Essex Waterworks Company has an extensive scheme in hand, though it has not yet reached the constructional stage. Application to Parliament was made this year and Royal Assent obtained in August last. Shortly described, the scheme comprises the abstraction of water from the River Stour at Langham, the construction of sedimentation reservoirs, filtration and pumping plant at that place, with a second pumping station at Tiptree, covered service reservoirs at Danbury and at Herongate, and the laying of a pipe line from Langham to Herongate, about 38 miles in length.

Glasgow.

The work in connection with the raising of the level of Loch Katrine, in order to obtain an additional supply, which has been in progress for several years, was practically completed by the end of 1927. The only construction work carried out in connection with it during 1928 was the making of one or two service roads for access to farms which were necessitated by the raising of the Loch. These roads are not yet finished. In Glasgow itself a considerable amount of pipe-laying was undertaken for the supply to new housing scheme areas, two of which, as they were at high levels, necessitated the putting down of small pumping stations.

Liverpool.

During the year the following works were carried out in connection with the Vyrnwy supply of the Liverpool Corporation Waterworks:—

Aber Tunnel.—The inlet heading of the Aber Tunnel was advanced 1022ft., which is the greatest length driven in any of the six years that the tunnel has been under construction. The tunnellers only work six shifts per week, and are using the old Temple-Ingersoll electric air drill.

In order to accelerate the rate of progress driving from the outlet end was commenced in February, 1928. A timbered heading 12ft. by 10ft. was driven into the hillside, through clay, interspersed with narrow bands of shale, for a distance of 308ft. At this point weak rock was encountered, but it was found necessary to continue the timbered heading to a total length of 513ft. There, the heading was changed to the circular section, with a minimum diameter of 7ft., and the present working face at a distance of 586ft. is in good hard rock. A small paraffin-driven electric generating plant was installed at the outlet end of the tunnel. It supplies current for lighting the heading, temporary buildings and offices and for driving the ventilating plant. Preparations are being made for the installation of a pneumatic rock drilling plant. The total length of tunnel driven to date is 5510ft., or 55 per cent. of the whole.

Vyrnwy Aqueduct.—In continuation of the policy adopted by the Water Committee of laying the third main of the aqueduct in sections, with cross connections to the two existing mains so as gradually to increase the total delivery of the aqueduct as and when required, work in connection with the laying of 6 miles of 42in. main was begun in June, 1928, on the section between Malpas and Cotebrook. Since the completion of the laying of 4½ miles of the third main on the Hirnant-Morda section, which was brought into commission in 1927, the delivery of the Malpas-Cotebrook section has been less than that of any of the other four sections of the aqueduct. The work in hand consists of the laying of a continuous length of 6 miles of the third main, alongside the existing two mains, with cross connections to both of these at each end and at two intermediate points. The pipes are of steel, $\frac{7}{16}$in. thick, lined centrifugally with bitumen, and protected on the outside by a double wrapping of hessian impregnated with bitumen. The pipes, which are in 25ft. lengths, are being supplied by Stewart and Lloyds, Ltd., of Glasgow, whilst the work of laying the pipes is being carried out under contract by Monk and Co., Ltd., of Irlam. Specially designed road carriages, running on rubber-tired wheels and hauled by fast petrol-driven tractors, have been used for transporting the pipes from the station of delivery to the line of aqueduct, and rapid progress has been made with the laying of the pipes. The length completed to date is 6703 yards, or 63 per cent. of the whole. Under favourable conditions as much as 487 yards has been completed in a week.

Oswestry Filter Beds.—The installation at Oswestry for filtering the Vyrnwy water consists of fifteen slow sand filters, having a total area of 12 acres and a capacity of 30 million gallons per day. To deal with the steady increase in the quantity of water drawn from Vyrnwy, four additional beds are now under construction. These are of the same size as the existing beds and of similar design to the last three that were brought into operation in 1925. The work is being carried out under contract by A. Monk and Co., Ltd., who commenced operations in June last. The main walls have now been completed, with the exception of the gaps in each pair of beds through which the material to be excavated from the interior will be removed. Good progress was also made with the laying of the numerous unfiltered and filtered water pipes and connections to the new beds.

Manchester.

Scarcely anything was done of any moment in Manchester beyond the ordinary extension of service mains. Of the Haweswater scheme, however, the main to supply the West Ward of the Westmorland Rural District Council was completed and is now in use. The fourth pipe line of the Thirlmere Aqueduct was also put into service.

Perth.

The new water supply works for the City of Perth, for which a provisional order was obtained towards the end of 1926, are now well advanced. The scheme provides for a supply of 3,000,000 gallons a day, to be taken from the River Tay beyond tide level and about 2 miles upstream from the City. One of its chief features is the provision of a reservoir holding 12,000,000 gallons, which, with one or two small existing reservoirs, will provide storage for five or six days' supply for all parts of the City. Hitherto the greater part of the City has practically been without storage and directly dependent upon continuous pumping. The new reservoir, which was completed during the year, is made with earthen embankments and a puddle trench and wall, all founded in clay, and the slopes and entire bottom are lined with concrete in order to preserve the purity of the water. The laying of a new 20in. bitumen-lined steel pumping main between the pumping station and the new reservoir, was also finished. Venturi meters have been placed on the new 20in. main, as well as on two existing 12in. mains through which the water is pumped to two existing reservoirs supplying the high-level districts. An up-to-date chlorinating plant has also been installed at the pumping station. The intake works comprise a collecting conduit and a

* No. I. appeared January 4th.

series of collecting galleries placed under the River level and covering an area of about 1000ft. by 100ft. in a gravel bank in the River. Half of this work was completed last summer and the other half, given favourable weather, should be completed next summer. The 30in. main from the intake to the pumping station is at present under construction, and it is hoped that it also should be completed by the end of next season. The supply conduit has to be taken across the River Tay, where, instead of a single 30in. pipe, two 24in. steel pipes are being laid, either of which can be emptied for cleaning purposes. The length of the crossing under the bed of the River is 800ft., and part of it was completed last season. Work at the intake and all along the supply main is largely dependent upon weather conditions which during the last summer were not too favourable, and in the previous summer were altogether bad.

Plymouth.

The operations in connection with the raising of the level of the Burrator Reservoir by increasing the height of the two dams which form it were completed in the autumn. Two dams were affected by these operations—the Burrator and the Sheepstor—the former a masonry and the other an earthen structure with a clay puddle wall. The works, which had been in progress for just over 4½ years, resulted in increasing the contents of the reservoir from 668 million gallons to 1026 million gallons, and the top water area from 117 to 148 acres. The top water level has been raised 10ft. from 708 O.D. to 718 O.D.

Sheffield.

The Ewden Valley.—The reservoirs and works which have been under construction in the Ewden Valley since 1914 comprise the Broomhead Reservoir, of 1142 million gallons capacity, the More Hall Reservoir of 480 million gallons, a Service Reservoir at Wadsley on the borders of the city, with a capacity of 10 million gallons, and 11¼ miles of trunk mains of from 36in. to 15in. diameter. At Broomhead Reservoir, the pitching and shingling of the inner face and slopes of the embankment were completed during the year, the valve control gear fixed in the valve shaft, and the floors practically finished. The concrete stop in the tunnel was fixed some months ago, and the New Mill Bank road diversion was opened for traffic. The More Hall Reservoir is practically completed, the valves are fixed, and the erection of the valve house is well in hand. The Paterson Engineering Company, Ltd., nearly finished the installation of thirty-two pressure filters and the concrete sludge lagoons were constructed. The total length of trunk main laid to date is 9¼ miles. It is expected the Reservoirs and Works will be brought into use within the next three months. The total expenditure incurred now amounts to £1,341,011.

Rivelin Pressure Filtration Plant.—During the year an extension of the Rivelin pressure filtration plant was brought into use. The station was formally opened by the Lord Mayor—Alderman M. Humberstone, J.P.—on September 19th last. The installation is designed to deal with Sheffield's share of the Derwent supply and to filter the final instalment of 4 million gallons per day, making a total of 7½ million gallons per day.

Burbage and Houndkirk Moors.—The Corporation has acquired from the Duke of Rutland the Burbage and Houndkirk Moors, comprising 2464 acres, situate within 7 miles of the centre of the city of Sheffield, with the object of constructing a reservoir to impound the waters of the Burbage brook and augment the high level supply. Under the provisions of a Bill promoted by the Corporation last session, the whole of this land will be included within the City limits.

Wakefield.

Our readers will remember that the powers which were obtained for what is known as the Ryburn Scheme in 1924 included the construction of two reservoirs in the Urban Districts of Rishworth and Soyland, to be formed by dams respectively 134ft. and 100ft. high above the level of the stream; a pipe line approximately 21 miles in length, consisting of 22in. and 20in. cast iron and steel pipes, with intake works, river, railway and canal crossings; a tunnel in the Urban District of Barkisland, some ½ mile in length; and mechanical filtration plant at Kirkhamgate, near Wakefield, designed to filter 2·6 million gallons of water per day.

Intake Works.—During the year the intake works consisting of a concrete dam, 30ft. in height, were completed and satisfactorily tested; 3 miles of 22in. cast iron and steel pipes were laid by direct labour and satisfactorily tested. The Tunnel at Barkisland, the internal size of which is 6ft. 6in. by 4ft., was being driven, lined with concrete and the inlet and outlet chambers and portals were completed.

Pipe Line.—The pipe line from the Barkisland Tunnel outlet to Ardsley Reservoir, 18 miles in length, consisting of 22in. and 20in. cast iron and steel pipes, was laid and it is expected that testing will commence early in the new year.

Reinforced Concrete Bridges, &c.—The bridges, four in number, over Sir John Ramsden's Canal, the River Colne at Bradley, near Huddersfield, the L.M.S. Railway at Warren-street, Dewsbury, and the River Calder at Dewsbury, were completed. The Balancing Tank at the outlet of the Barkisland Tunnel, which has a capacity of three-quarter million gallons, and basins at Ardsley Reservoir, were also finished.

Filter House and Plant.—The house and installation of mechanical filters were completed some time ago; the filters are still under test. Up to the present the test has proved to be satisfactory.

Ryburn Reservoir.—This reservoir, which will be formed by a concrete dam having a height of approximately 100ft. above the river bed, is being constructed by direct labour. The access road, house and all temporary works, including the installation of power from the Yorkshire Electric Power Company, were finished. During the year the major portion of the excavation for the heel trench and foundation of the dam was got out. Quarries were opened, concrete-mixing plant installed and concreting in the heel trench was commenced last November. Progress in this work during the year was satisfactory. Preparations have been made for cementation beyond the limits of the heel trench.

The estimated cost of the whole scheme is £930,000; that of works now in hand is about £600,000.

Irrigation.

A very large amount of irrigation work is being carried out in various parts of the world; so large is it indeed that it would be out of the question to attempt even to give a list of the schemes which are in progress in America, Australia, India, and South Africa. In what follows, however, particulars are given of four undertakings in India, two of which reached their final phases during the year. We are also able to give some information regarding the progress made to date with the Nag Hammadi Barrage, which is being built on the Nile.

The Lloyd Dam.

The huge dam at Bhatgar in the Bombay Deccan—known as the Lloyd Dam—was formally put into service on October 27th, by Sir Leslie Orme Wilson, the Governor of Bombay. This enormous structure, which is 5333ft. long, has a maximum height above foundations of 190ft. and a maximum width at the base of 124ft., is capable of impounding 24,200 million cubic feet—or over 150,000 million gallons—of water. It contains no less than 21½ million cubic feet of masonry, and it has been built to furnish supplies of water to the Nira Right Bank and the Nira Left Bank irrigation canal systems. The quantity of water held up would submerge to a depth of 1ft. an area of 868 square miles, or nearly four times that of the Isle of Man. As regards the canal system, it may be explained that the main Left Bank canal is 100 miles long and the main Right Bank canal 106·5 miles These canals between them command 834,104 acres, and it is estimated that their distributing channels will irrigate rather over 200,000 acres annually. The canal head works are 17 miles downstream of the dam. The total cost of the dam was 172 lakhs of rupees, or nearly £1,300,000 at the present rate of exchange, and the estimated cost of the whole irrigation scheme is given as being 557·02 lakhs of rupees, or over £4,175,000.

The Sarda River Irrigation Scheme.

The Sarda River Irrigation undertaking was declared open for service on December 11th by Sir Malcolm Hailey, the Governor of the United Provinces of Northern India. This scheme, which is of a most important character, has entailed the building of a dam across the River Sarda just where it leaves the foothills of the Himalayas, and it commands an area of more than 7,000,000 acres. The main canal, which has a bottom width at its head of 350ft., is 27 miles long and some 8ft. deep, when running full. It feeds altogether some 4000 miles of subsidiary canals and distributing channels. It is anticipated that well over 1,000,000 acres will be irrigated in dry years. The main barrage has thirty-four openings, each 50ft. wide, which are controlled by steel gates. The canal head works contain sixteen openings, each 20ft. wide. The estimated cost of the whole undertaking is given as being some £7,500,000.

The Sukkur Barrage.

Work on the great Sukkur Barrage, which is to provide the water for irrigating a large part of the province of Sind, and which will be the largest work of its kind in the world, continued throughout the year. This huge structure will have sixty-six openings, each 60ft. wide, which will be controlled by gates, 18ft. 6in. deep. Seven of the gates on the left of the barrage and five on the right will be separated from the remaining fifty-four gates by long dividing walls. They will act as under-sluice or scouring gates, and will maintain a pond at each bank in front of the canal headworks. Elsewhere in the barrage, the openings will be separated by piers, 10ft. wide, except that every ninth pier in the centre portion will be 25ft. wide. The gates will be counterbalanced by concrete blocks and will have a lift of 32ft. to provide for the free passage of floods. It was announced early in the year that the order for the gates, each of which will weigh 40 tons, and will have to support a water load of 300 tons at full supply level, had been given to Ransomes and Rapier, Ltd., of Ipswich. This firm, it may be recalled, was some little time ago entrusted with the order for the gates, grooves, sills, and operating mechanism for the head regulators of the seven canals which will take off from the barrage. There are to be fifty-five openings for these canals, each with a span of 20ft., and each fitted with three gates varying in depth from 4ft. to 8ft. 9in.

The Sutlej Valley Project.

Another important Indian irrigation scheme is the Sutlej Valley project. This undertaking involves the construction of four barrages or weirs on the river Sutlej, *i.e.*—to take them in order downstream—the Ferozepur, the Sulaimanke, the Islam and the Panjnad—the last coming after the junction with the Chenab River to form the Panjnad River, which flows into the Indus. Constructional work was begun in 1922 and, so far, two of the four weirs have been completed, the Ferozepur having been put into service in 1926 and the Sulaimanke in October, 1927. When carried out in its entirety the scheme will command over nine million acres, of which, it is estimated, over five million will be brought under annual cultivation. The total cost is estimated at over fourteen crores of rupees, or approximately £10,500,000. The cost of the Ferozepur weir alone was some £1,350,000.

The Nag Hammadi Barrage.

A contract was let by the Egyptian Government in May, 1927, to Sir John Jackson, Ltd., for the construction of a Barrage across the Nile at Nag Hammadi. The summer months of 1927 were taken up in ordering plant and assembling materials. A complete colony of houses for the staff, together with all the usual workshops, electric power plant, railways, &c., were put in hand, and were completed about November of last year. A hospital and a wharf for landing materials had to be constructed at Nag Hammadi, and quarries had to be opened out for granite, limestone, and sand.

A commencement was made in November, 1927, when the annual flood on the River was subsiding, with the construction of the sudd, or temporary dam, around the first season's work on the west bank of the River. This portion of the work consisted of the lock, with guide walls and aprons, also twenty vents of the Barrage proper. The sudd was completed in January, 1928. In the meantime, the erection of five cableways across the River had been put in hand, and proceeded steadily until the fifth was completed and handed over in June. The excavation and pile driving for the lock was began in January, 1928, and concreting the foundations was started on March 17th following. Work proceeded steadily throughout the summer months, until the rising river made it necessary to cut the sudds and let in the water on July 23rd.

The work carried out during the season comprised the completion of the lock, and the floor of the barrage, with ten piers of the Barrage. It was not possible to complete the floor and the second ten vents of the Barrage, but the Contractors arranged to complete all the walls of the lock up to the underside of the coping instead, whereas the original intention was to complete these walls for only half their height.

No damage was done to the permanent works during the flood, and work on the new sudd for the second season's work, which enclosed fifty vents of the Barrage, was begun in October last, and was continued during October, November and December. It is expected that this temporary dam will be closed so that excavation, pile driving, and concreting can be commenced on the second season's work during the present month.

Cape Town.

The second section of the Steenbras undertaking, by which Cape Town is supplied with water, was completed at the end of May. This second section of the scheme, which was started upon some four years ago, comprised:—(*a*) The raising of the Steenbras dam by 40ft. to a height of 112ft. above foundation level; (*b*) the construction of a concrete outlet tower; and (*c*) the laying of a second pipe line from the reservoir to Cape Town. The surface area of the reservoir was increased to some 808 acres. The length of the pipe line is 33 miles. It consists of cement-lined steel pipes with a finished internal diameter of 32in. The maximum head which it has to withstand is 285 lb. per square inch. When tested, the pipe line was found to discharge at the rate of 11,400,000 gallons per day, which was 10 per cent. in excess of the specified volume. The Steenbras catchment area is 23½ square miles in extent, and it is estimated that, in a dry year, after deducting evaporation losses, it will yield an average of 20,000,000 gallons per day when balanced by the reservoir. The ultimate average summer draw-off will be about 25,000,000 gallons per day and the winter draw-off 15,000,000. It is anticipated that the two pipe lines now in service will meet requirements until about the year 1946–47, and that it will become necessary to begin laying a third pipe line in, say, 1936, though the length of time before it is needed will, of course, depend upon the growth of population of the city. No further supply can be obtained from the Steenbras valley, but by tapping one of the tributaries of the Palmiet River at a higher level, and

diverting it into the Steenbras valley, an additional 5,000,000 gallons could be made available.

France.

With the increasing demands of Paris and the suburbs the supply of water is certain, in a comparatively short time, to become so far deficient that the Municipal Council has been making special efforts to remove the difficulties that stand in the way of carrying out the scheme for bringing water from the Vals de Loire. Despite the opposition from the populations in the valley of the Loire, a preliminary inquiry has been instituted by the Prefects of the Departments interested, and in most cases the Chambers of Commerce have approved of the scheme on condition that it does not cause any prejudice to the local inhabitants. That leaves the Council in much the same position as it was before, and it seems fairly certain that efforts will be made to get a Bill passed through Parliament declaring the Vals de Loire project a "work of public utility," which means that local objections will be overruled. Meanwhile, a considerable amount of pumping of the subterranean water continues to be done as a means of proving that there is not likely to be any failure of supply, and that the raising of a million cubic metres of water a day will not affect the level of the river Loire. As a further precaution, it is intended to construct a barrage reservoir of sufficient capacity to minimise the floods that invariably occur in rainy seasons and to return the water to the river in times of drought. It is hoped that this proposal will remove the local objections to the scheme. As the necessary dam could not be completed for some years, the Paris water supply is being increased as much as possible by treating water from the Marne by ozone, but even in that direction the limit has been nearly reached, and the only other sources of supply available are the reservoirs which it is proposed to form in the upper valley of the Seine, although objections are made to the distribution of this water in Paris. At Bordeaux and in other towns works have been completed for increasing the water supply, and at Carcassonne an installation for the treatment of river water by the Philippe Bunau-Varilla process was put into service during the year by the President of the Republic at the time of his visit to that city. It is claimed that the process has entirely suppressed the periodical epidemics of typhoid fever which proved so disastrous in the past. There has, however, been no further application of this special chlorine method elsewhere.

Singapore.

In connection with the scheme for taking an additional supply of water to Singapore from Johore, the building of the Gunong Pulai Dam was in progress throughout the year, and it was expected to be finished by the end of December, when filling of the reservoir would begin. The tunnel by which water from an adjacent stream is to be diverted into the Gunong Pulai Reservoir, and which is 1146ft. in length, was completed, and the intake weir on the stream is now being constructed. Practically the whole of the mechanical installation in connection with the Paterson filters has now been shipped from this country, and the building work is well advanced. It was hoped that the Fort Canning Service Reservoir would be finished by the end of the year. Operations on the Pontian Kechil Reservoir, which will form the second instalment of the scheme, were actively carried on. The principal works there, are a main embankment, 400ft. long and 70ft. high, with a concrete cut-off and a reinforced concrete core wall; a subsidiary embankment 2700ft. long and 40ft. high, with a steel sheet piling cut-off about 50ft. deep, and a reinforced concrete core wall; and a pumping station. The reservoir formed by the embankments will be about 10,000ft. long, with an average width of about 3000ft. At the main embankment site, the overflow shaft and outlet tunnel are nearing completion, and excavation for the concrete core trench is in progress throughout its length. At the subsidiary embankment site the driving of the sheet piles is approaching completion. A 30in. diameter pipe line, about 3½ miles long, will be required to convey the Pontian Kechil Supply to Gunong Pulai, but the laying of it has not yet been started.

Other Works Abroad.

Salisbury in Southern Rhodesia has in hand extensions to its water supply system. Auckland, New Zealand, is installing Candy mechanical filters. The town of Fashn, Egypt, proposes to lay down an extensive pumping plant and filters. Buluwayo intends to install electrically-driven pumping plant. Adelaide, Cape Province, has in hand a water supply scheme to cost £35,000. Work was begun on a new potable water supply scheme for the town and suburbs of Cordoba—Argentina. The scheme involves the piercing of two tunnels—one 15 furlongs and the other 5 furlongs long—and the construction of several dams. Filtration and sterilisation will be employed. The scheme is to cost some 6,000,000 pesos (paper). The Avon dam of the Sydney water undertaking was completed. Supply schemes of greater or less importance are proposed for Lahore, Lima, Rangoon, and Shanghai. Some £55,000 are to be expended on a supply scheme for Witbank, South Africa. It is proposed to construct an aqueduct capable of conveying from 20 to 30 million gallons of water a day up the Yarra Valley, beyond Warburton, for augmenting the water supply of Melbourne. The Kwantung Government has decided to construct a large reservoir with a capacity of over 3,300,000,000 gallons of water between Dairen and Port Arthur, at a cost of £555,700. The work is expected to take five years to carry out. An extensive scheme of sinking tube wells for water supply in the Sadar and Serampore districts of India. Over 600 wells are, in all, to be sunk. A water supply scheme for Tivandrum has been sanctioned. It is proposed to form a lake of 14 square miles area and to furnish 4,500,000 gallons of water a day. The supply conduit will be 8 miles long. The estimated cost of the scheme is 35 lakhs—say, £262,000. Work has been started on the lowering by 15ft. of the crest of Boyd's Corner Dam in New York's Croton Watershed. The dam was completed in 1872, and was showing signs of failure. The City of Ottawa proposes to expend 1,315,000 dollars on a rapid filtration plant to deal with 34 million gallons of water a day. Work in connection with the extensive undertaking at Calcutta, which was described in our issue of April 13th last, was continued during the year. The scheme for providing an additional supply for San Francisco entails the construction of an aqueduct 156 miles long, which will be carried under the Bay of San Francisco, under two ranges of mountains, and across miles of open plain. For the passage through the mountains, 28 miles of concrete-lined tunnel are required. By the middle of the year only some 21 miles of the aqueduct had been completed, and it is estimated that it will take another five years before the whole scheme is completed. A scheme for running pipes in a dredged trench across the harbour at Hong Kong, so as to connect Kowloon with the existing system at Victoria, was under consideration. An alternative proposal is to construct a subway in tunnel under the harbour and to use it either as an aqueduct or for two lines of supply pipes. Government approval has been given to the Rietvlei scheme, by which Pretoria proposes to obtain by gravitation an additional supply of 2,000,000 gallons a day by the construction of a dam to impound 511 million cubic feet of water. Contracts were entered into for the construction of a second tunnel in the Catskill water supply system for New York, the total amount involved being 42,692,876 dollars. The tunnel will have a diameter of 17ft., and will take about six years to complete.

The Collapse of the St. Francis Dam.

A terrible disaster occurred during the night of March 12th, when the St. Fancis Dam, which formed part of the water supply system of Los Angeles, ruptured and released the large volume of water impounded behind it. As a result, there was a rush of water down the San Francisquilo Canyon, which carried everything before it, so that many lives were lost—according to latest information 426—and an enormous amount of material damage was done. A curious feature of the failure was that, though both ends of the dam were completely destroyed and carried away downstream, a portion, which was approximately in the centre of the structure and some 100ft. wide, remained standing and intact. Several commissions inquired into the circumstances. They were practically unanimous in their findings, and endorsed the verdict of the coroner's jury. The jury which investigated the loss of life and which, in view of the fact that much of the evidence to be brought forward was of a technical character, was composed of engineers and engineering contractors, came, without dissentient, to the following conclusion: "The St. Francis dam was defective, due to the very poor quality of the underlying rock structure upon which it was built, and to the fact that the design of the dam was not suited to inferior foundation conditions. The actual failure was caused wholly or in part by these defects."

Steamships and Steam Marine Engineering in 1928.

No. II. (*Conclusion*).*

Recent Marine Boiler Practice and Pulverised Fuel.

REFERENCE was made last week to the 250 lb. and 350 lb. water-tube boilers designed and built by Yarrow and Co., Ltd., and their licencees for the Canadian Pacific "Beaver" and "Duchess" class ships. In the newer ships pressures up to 425 lb. will be used. Messrs. Yarrow also built six 350 lb. marine water-tube boilers for the new turbo-electric P. and O. liner "Viceroy of India." They were described in THE ENGINEER of July 21st. The firm is also building a 1200 lb. pressure boiler for its own experimental purposes. During a recent visit to Scotstoun we were shown the new Yarrow pulverised fuel burner, which is working successfully both with water-tube and Scotch marine boilers used for works purposes. Alternative arrangements are made whereby either an "Atritor" pulveriser or a Kennedy van Saun ball mill may be utilised to prepare the fuel.

At Renfrew Babcock and Wilcox, Ltd., completed eight 250 lb. pressure water-tube boilers for the C.P.R. "Beaver" class ships, and fitted eighteen 225 lb. pressure boilers on the cross-Channel steamers already referred to. They also built six 400 lb. pressure water-tube boilers for the Dutch liner "Statendam." In December we visited the Renfrew works and inspected the new boiler engineering plant which Babcock and Wilcox, Ltd., have recently put down for the manufacture of riveted drums up to 2¼in. plate thickness, with working pressures up to 650 lb. A full account of this plant will be found in THE ENGINEER of December 7th. During the year John Brown and Vickers-Armstrongs, Ltd., supplied large forged drums for boiler work. On the Continent lap-welded drums having a wall thickness of over 3in. and a diameter of 4ft. 6in. were produced. So far this type of drum has not been used in British marine practice, but there are indications that it may be of service to marine engineers. The Howden combined Scotch and water-tube boiler we illustrated in last year's annual is to undergo a series of tests in the works of R. and H. Green and Silley Weir, Ltd.

The pioneer work done by Clarke, Chapman and Co., Ltd., on the burning of pulverised coal in Scotch boilers was turned during the year to excellent use on the Blue Star cargo liner "Stuartstar." Early in the year the forward stokehold single-ended boiler in the ship was turned over to pulverised fuel and in November the "Stuartstar" left London with her port double-ended boiler also fitted in the same way. The six furnaces are equipped with Woodeson type burners, and are fed by a ring main direct from "Resolutor" pulverisers. This is the first double-ended boiler to be so fitted, and the results are so satisfactory that the other boiler will be equipped in the same way at an early date. The steam-keeping qualities of the installation are very good, and much saving is made, owing to the steady firing, and absence of the usual fire-cleaning operations. Coal at 9s. 2d. per ton was used, as against that at 14s. 9d. per ton for the hand-fired furnaces. The firm of Clarke, Chapman and Co., Ltd., has also been entrusted with the equipment for the new "Berwindmoor" collier, and on this ship the latest type of Howden-Woodeson furnace front will be fitted.

The equipment of the New Zealand Shipping Company's cargo steamer "Hororata" with Howden-Buell burners in the forward stokehold was carried out by R. and H. Green and Silley Weir, Ltd., at Falmouth last month, and the steamer left for New Zealand. The arrangement of the plant is a very neat one, and its trials were successful. An account of this system was given in THE ENGINEER of Decem-

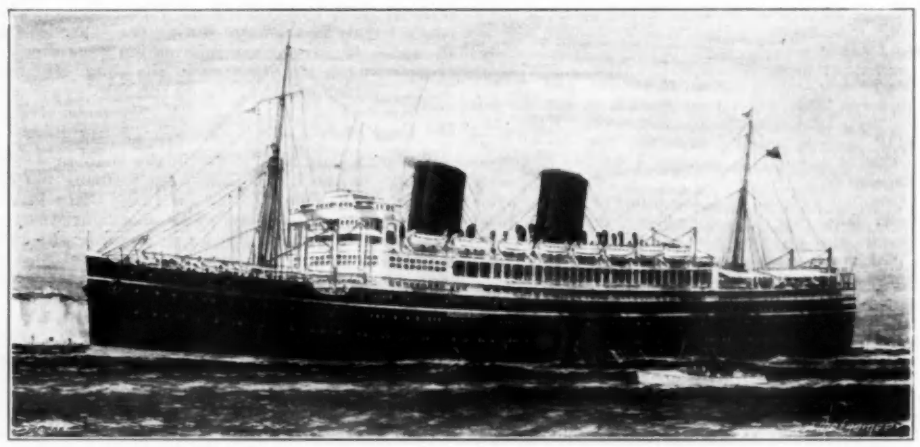


FIG. 4. THE TURBO-ELECTRIC P. AND O. LINER "VICEROY OF INDIA" AS COMPLETED

* No. I. appeared January 4th.

ber 14th. In order to further the development of pulverised fuel, the Admiralty lent to the Department of Industrial and Scientific Research and the B. & N. Fuel Company surplus ships for experiments with pulverised fuel. In the depôt ship H.M.S. "Maidstone" the Brand Powdered Fuel Company, Ltd., is to install a pulveriser and distributor and fit the boiler furnaces with Brand type burners. The object of this installation is to demonstrate both the use of pulverised fuel prepared on the ship and the loading and unloading of powdered coal on the Brand bin system. There is no doubt that the immediate need is for research relating to the problems of the handling and the preparation of fuel rather than the burner problem, which has been to a large extent solved. In this matter the active assistance of the mineowners would be welcomed, as success in burning powdered fuel at sea will immediately demand better bunkering and coal transport facilities for pulverised fuel.

Turbo-Electric Propulsion.

The launching of the new P. & O. liner "Viceroy of India" at the yard of Alexander Stephen and Sons, Ltd., on September 15th, was an occasion of unusual interest, since this vessel is the first of her kind to be built in a British yard. The propelling machinery, supplied by the British Thomson-Houston Company, Ltd., of Rugby, has now been installed, and when we visited the ship a few weeks ago we were impressed by the remarkable advance made towards her completion. She is to be ready for trials about the end of next month. At present she is fitting out at Linthouse, and we are enabled, by the courtesy of her owners, to reproduce from a painting by Mr. J. Spurling a view of the completed vessel—see Fig. 4. She is a handsome ship of 610ft. overall length, with a beam of 80ft. and about 25,000 tons displacement, with a gross tonnage of 19,000 tons. The passenger accommodation is very pleasing and arrangements are made to carry 415 first-class and 258 second-class passengers. The chief interest centres in her twin-screw turbo-electric propelling machinery supplied by the British Thomson-Houston Company, Ltd., and in Figs. 5 and 6 we give views of the main control panels and one of the propelling motors with its rotor. Each motor has a designed output of 8500 S.H.P. at 109 r.p.m., which at full power will give the ship a speed of 18¾ knots. The power is supplied by two 9000-kW turbo-alternators, running at 2700 r.p.m. The design is such that the plant can be run with high economy and with one alternator in reserve, giving a speed of 16½ knots. If a higher speed is required to compensate for delays caused by heavy weather or any other reason, both turbo-alternators are brought into service, and the plant is so designed that a total of 17,000 S.H.P. can be developed continuously. In Fig. 5 a view of the control unit assembled in the builders' shops is given. It consists of a steel cubicle with a planished steel instrument panel in front of which the main control levers are placed. The panel contains all the necessary instruments, including the electrically operated tachometers to enable the engineer on duty to control effectively all propeller speed changes. At the forward end of the cubicle there are three interlocked hand wheels by means of which either or both of the turbo-alternators can be brought into service. The circuits are opened and closed by solenoid and cam-operated contactors, and only a minimum of effort is necessary, so that one engineer can manipulate the controls for both propellers. The auxiliary switchboards control the power circuits for four 500-kW auxiliary turbo-generator sets, and two 165-kW oil engine driven sets for port use. There are forty-three circuits for pumps, fans, steering motors, and other electrically driven auxiliaries, and most of the wiring for the deck auxiliaries is carried out on the Austin constant-current system, a description of which was given in our issue of November 16th. The circuit breakers on the oil-electric generator panels are interlocked with the equaliser switches, so that the equalising circuit must be established before the breakers are closed, and opened before they are tripped. The directional current trips on all the circuit breakers are specially designed to prevent their accidental operation by the rolling or pitching of the ship and the circuit breaker handles are also safeguarded in this respect.

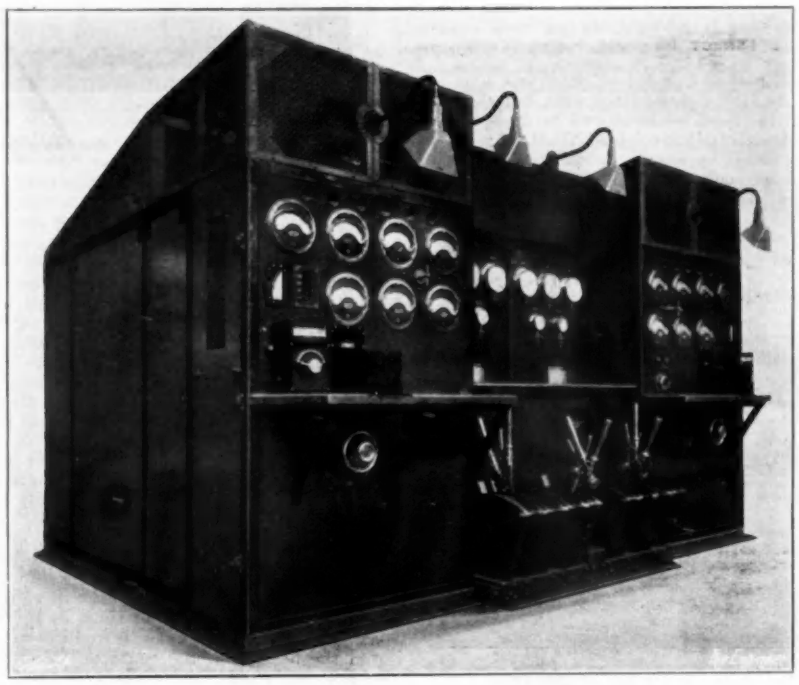


FIG. 5—THE CONTROL PANEL OF THE "VICEROY OF INDIA"

The increased efficiency of the high speed turbo-alternators added to the elimination of the reversing turbine and its attendant losses, introduced by cross-over connections, and additional sealing glands, &c., together with the very efficient boiler and condenser installation, have enabled a very high thrust efficiency to be maintained throughout all sections of the equipment. The guaranteed fuel consumption at a speed of 18 knots is understood to be less than 0·6 lb. per S.H.P. hour for propulsion purposes only. The trials of the "Viceroy of India" will be among the most interesting of this year.

Some Important Steamships Constructed Abroad.

The performance of the "California," the first electrically-propelled passenger liner built to the order of the Panama-Pacific Line—see last week's Supplement—was followed with interest throughout the world. This ship was described in the issues of THE ENGINEER of September 9th and October 2nd, 1927, and she underwent successful trials late in that year. Her first voyage from New York to San Francisco took place on January 28th, 1928. A representative company of British engineers was on board, and tribute was paid to the steadiness of the ship and the absence of vibration or propeller racing even although heavy weather was encountered. The "California" has an overall length of 601ft., with a beam of 80ft. and a gross tonnage of over 20,000. She was built by the Newport News Shipbuilding and Drydock Company, of Virginia, and her propelling machinery was supplied by the General Electric Company, of Schenectady. The twin-screw propelling motors have a total output of 17,000 S.H.P. at 18 knots, and the two turbo-alternators are each designed for an output of 8500 S.H.P. at a speed of 2880 r.p.m., corresponding to a propeller speed of 120 r.p.m. The boilers are of the Babcock and Wilcox oil-fired water-tube type, with a working pressure of 275 lb. and 120 deg. Fah. superheat. The average fuel consumption on the first voyage worked out at about 0·8 lb. of oil for all purposes, and was reduced to 0·77 lb. on the second trip. In Fig. 7 we reproduce curves derived from the engine-room logs of the first and second voyages. These curves are taken from the paper describing the ship, which was read before the American Society of Naval Architects and Marine Engineers in New York in November last. The paper was prepared and read by Mr. Roger Williams, of the operating department of the International Mercantile Marine Company, of New Jersey, of which the Panama-Pacific Line is a subsidiary company. Towards the end of December the sister liner, the "Virginia," ran successful trials. She is about 12ft. longer than the "California," and embodies several improvements. A further liner is in course of construction. A new Grace liner will also be a turbo-electric ship.

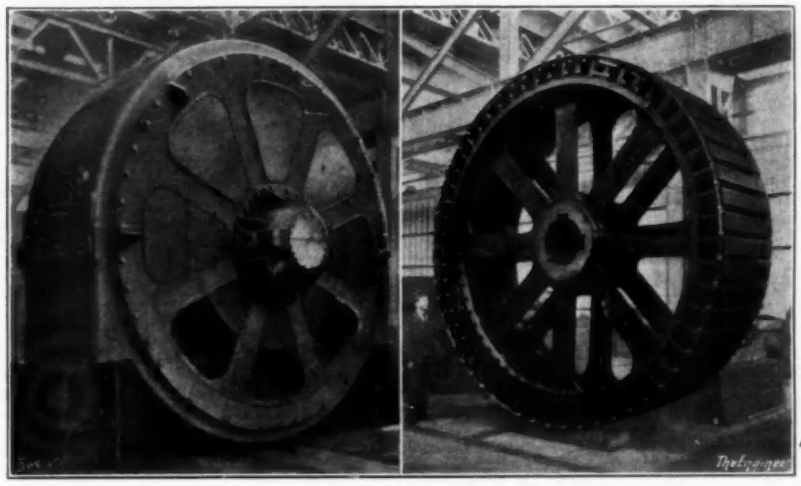


FIG. 6—PROPELLING MOTOR AND ROTOR, "VICEROY OF INDIA"

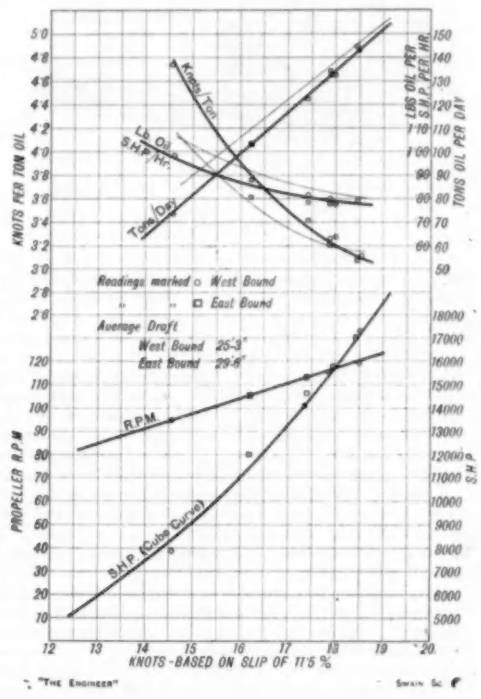


FIG. 7—CHARACTERISTIC CURVES, S.S. "CALIFORNIA"

In Germany the launch of the two North German Lloyd express Atlantic liners, "Bremen" and

"Europa," was an occasion for widespread interest. These ships, which were built at the "Deshimag" Weser yard, Bremen, and Blohm and Voss's yard in Hamburg, are designed for a speed of over 26½ knots. They have a gross tonnage of about 40,000 and are propelled by high-pressure geared turbine machinery. No official particulars are available concerning the machinery, but it is understood that the turbines will have a total output of nearly 100,000 S.H.P., and the steam pressure employed will be about 375 lb. per square inch with a moderate degree of superheat. A feature of the hull construction is the use of a bulbous bow, and it is of interest to know that three-quarters of the total number of propellers required were ordered from British firms. These liners were to be ready for the spring of 1929, but the German shipyard dispute delayed their completion

A liner of more than usual importance is the "Statendam," which was built by Harland and Wolff, Ltd., and during the year was fitted out by Wilton's, of Rotterdam, for the Atlantic service of the Holland-America line. The high-pressure turbine propelling machinery was built by Harland and Wolff, and its output has been given as equivalent to 21,000 I.H.P. A steam pressure of about 400 lb. will be employed in boilers supplied by Babcock and Wilcox, Ltd. The trials of this ship will take place early in the present year.

Physical and Optical Societies' Exhibition.

No. I.

ON Tuesday last the annual Physical and Optical Societies' Exhibition was opened at the Imperial College of Science and Technology, South Kensington, and, as usual, it proved to be a very interesting show. It lasted for a period of three days, closing on Thursday, January 10th. During the course of the Exhibition three lectures were delivered, one on "Experiments with High-frequency Sound Waves," by Professor F. Lloyd Hopwood; one on "Lenses," by Mr. Conrad Beck; and a third on

FIG. 1—DIRECTION FINDER

"Some Colour Problems in Photo Engraving," by Mr. A. J. Bull. For some years past electrical exhibits have predominated, and on this occasion they appeared to be more numerous than ever. Electrical instruments for practically ever class of service were on view, as well as a large quantity of wireless apparatus. The research and experimental section was quite up to the usual standard. Electrical and other firms that have experimental laboratories now invariably provide this section with much of scientific interest, notably such firms as the General Electric Company, the B.T.H. Company, and the Gramophone Company. The Exhibition Committee hopes that in future years the scope and utility of this section will be still further extended by the co-operation of Fellows of the Societies and others who may be able to contribute to it.

New apparatus representing recent developments in wireless work was exhibited by the Marconi Company. Besides wireless receivers and transmitters, there was a signal strength measuring set, with a wave range of from 14 m. to 5000 m., and a tuning fork and thermostat unit for maintaining constant frequency in facsimile transmission.

The latest type of direction finder, type 11G—see Fig. 1—for use in merchant ships was shown for the first time. This receiver is used in conjunction with a fixed frame aerial and possesses a number of important features, the chief of which are the screened valve amplifier, which is highly efficient and stable in operation, and a radio goniometer provided with two scales, one for reading bearings relative to the ship's head and the other for reading true bearings. The instrument covers a wave range of from 400 m. to 1100 m., and the circuits are easily and quickly tuned to any wave length within this range for the reception of spark, interrupted continuous wave and telephone signals.

The first model of the type A D 18 wireless telephone and telegraph set for aircraft was on view. This installation has been specially developed for use in two-seater and larger aeroplanes, seaplanes or flying boats, for transmission and reception of wireless telephony and telegraphy. Telegraphy can be carried out both on the tonic train and continuous wave systems. The transmitter, with a wave range of 300 m. to 1600 m., has an anode rating on continuous wave telegraphy of 190 watts, and for telephony 176 watts. The transmitter and receiver, constructed as independent units, are mounted in special boxes made as light as possible, consistent with reliability

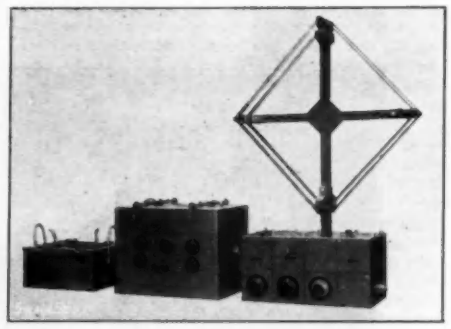


FIG. 2—SIGNAL STRENGTH MEASURING SET

and robustness. If required, arrangements can be made for the remote control of the transmitter and receiver.

The signal strength measuring set, shown in Fig. 2, is an instrument of considerable value to authorities allocating transmitting licences, for research workers in wireless phenomena, and for those responsible for commercial wireless stations. A frame aerial for the reception of the desired signals is mounted on a coupling unit, which also contains a means of attenuating the signals produced by a local oscillator. The local oscillator is capable of being tuned from 14 m.

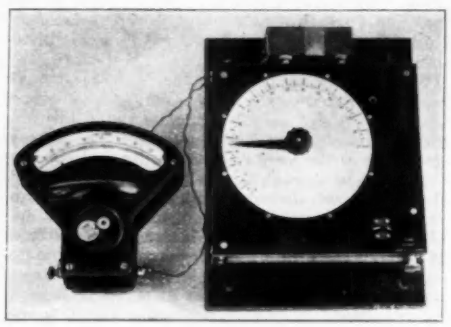


FIG. 3—DIRECT READING MICROMETER

to 5000 m., and is coupled to the frame and to a receiver. By means of the attenuator unit the signal strength of the local oscillator can be measured and can be made equal to the received signal. The signals can be equalised by ear or, in the case of rapidly varying signals such as occur in the short wave band, the receiver output can be calibrated on a recording device. The local oscillator output is adjusted to be of exactly the same frequency as the signals to be measured and the current is measured by a thermo-milliammeter. As reception is done on a frame, the set will measure primarily the magnetic field in the

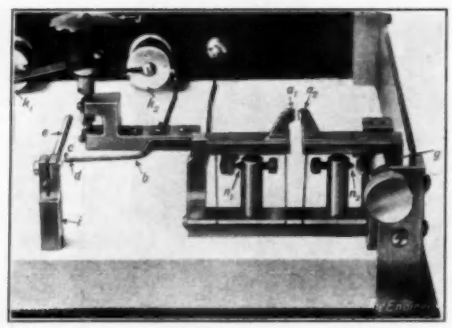


FIG. 4—MICROMETER MECHANISM

wave at the point considered, and the audio intensity of the signal produced is measured by comparison with the known signal strength of the local oscillator. The attenuator and coupling unit, the local oscillation generator and the battery box are each contained in a heavy metallic shielding case which completely screens these units from external interference.

Evershed and Vignoles, Ltd., exhibited for the first time a Dionic salinometer, an electrical instrument operating on the same principle as the well-known "Dionic" water tester, and giving the salinity of a solution directly in grains of chlorine per gallon. The instrument was shown in two patterns, with and without temperature compensation. A 7000-volt direct-current motor-driven testing equipment that was exhibited by this firm is for flash tests and other high-voltage tests. Several sets have been supplied to manufacturers for the flash test of insulation of parts, and similar motor generators to university and other testing laboratories for cathode ray and other research work. The firm's Midworth distant repeater was shown in three types—(*a*) for transmitting "mechanical" information, such as changes of level in reservoirs; (*b*) for transmitting "electrical" information, such as total load in power stations; and (c) for distant control of power-driven apparatus—all these being shown in operation. Several minor refinements have been incorporated in the transmitter since the last Exhibition.

One of the exhibits of the Cambridge Instrument Company, Ltd., was a direct-reading micrometer for measuring the diameter of quartz fibres. This apparatus—illustrated in Fig. 3—consists of a square box with glass walls and a metal cover mounted upon a wood base, together with a 2-volt dry cell and a galvanometer which serves merely as an indicator. The cover of the box bears a large white scale, which is divided in seventeen large divisions, each division reading one-thousandth of a millimetre (1 micron). The large divisions are 2 cm. long, and give a magnification of 20,000, and are subdivided into four, so that direct readings may be taken to 0·25. This magnification is obtained by the method shown in Figs. 4 and 5. The fibre to be measured is placed between the jaws a_1, a_2, and rests on two little cross bars mounted on the cover. The jaws are carried on thin flat steel springs, which admit of a slight motion of the jaws, the stops n_1, n_2 limiting this motion. To open the jaw the right-hand jaw a_2 is moved by turning the milled head of a cam *g*, a stop on the side of the cam screw preventing damage by overturning. When the fibre is inserted and the gap closed, the left-hand jaw, nominally fixed, is slightly deflected in a plane at right angles to the paper, and this jaw is

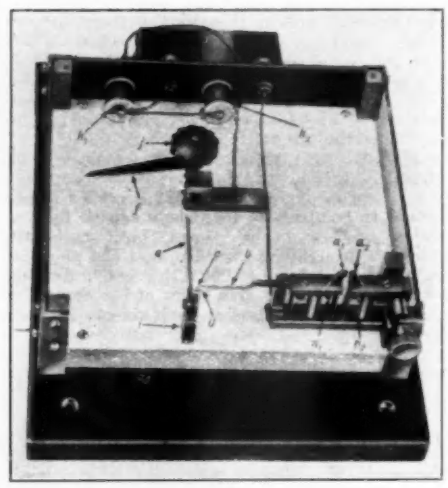


FIG. 5—INTERIOR OF MICROMETER

connected to an amplifying jointless lever *b* carrying a platinum contact *c*, which normally touches another contact *d* mounted on the fine helical spring *e*. One end of the spring is connected to the pointer *f* and the other to the brass pillar *i*, so that when the pointer is rotated the spring is extended. The presence of the fibre in the jaws deflects the lever and breaks the normal contact, which is re-made by moving the pointer round the scale. The point at which contact is re-made is indicated by the deflection of the galvanometer, one terminal of which is connected through the dry cell to the amplifying lever *b*, and the other terminal to the spring *e*. Completion of the circuit is made by the contacts *c* and *d*. The instrument is set to zero before each reading by closing the jaws and setting the pointer *f* at the zero position on the scale. This pointer is not connected to the knurled knob *j* by which it is rotated, but is a friction fit, so that the pointer can be moved independently, although its movement round the scale is limited by a stop. Since the electrical circuit is broken only at the two contacts, care must be taken not to leave the battery connected for any length of time, as the continued passage of the current may introduce errors arising from the heating of the contacts. Two resistances K_1 and K_2 reduce the current passing when the circuit is completed. The flat steel springs ensure good contact between the fibre and the jaws without compressing soft wires or fibres.

Another of the Cambridge Instrument Company's exhibits is the rotational accelerometer, shown in Fig. 6. This instrument is designed for recording changes of angular velocity in any rotating member and enables irregularities or cyclic fluctuations in the rate of turning to be easily traced and measured. It may also be used to detect torsional resonance and the effect of such resonance on the running of an engine or accessory apparatus. The apparatus may be applied to any revolving machine, and is particu-

larly useful for internal combustion engines, and all varieties of rotating electrical machines. The illustration given below shows the instrument with the cover removed to exhibit the mechanism. A A wheel A, mounted on a horizontal spindle, is driven by the engine under test by a form of belt which accurately transmits the instantaneous angular velocity. When making a test the belt can be readily joined up on site in a few moments, and may be driven from any small length—from ⅜in. upwards—of exposed shaft or from a small pulley or coupling mounted on the shaft. To the driven wheel A is flexibly attached a heavy wheel B, which is carried on the same spindle, but mounted entirely separately from the driven wheel. The peripheral speed of the heavy wheel B quickly becomes steady and tends to remain so while the peripheral speed of the driven wheel A varies with the instantaneous variations in the rate of turning of the engine shaft. The difference in the angular positions of the two wheels is transmitted to a stylus S by means of a novel form of flexible link which eliminates back-lash. The stylus S is pressed lightly into contact with a continuous strip of celluloid C—12 mm. wide—which is moved by means of a clockwork mechanism at a speed which can be varied over wide limits. By these means a permanent and clearly defined record of the variations in the rotational velocity is traced in the celluloid surface. This method of recording, which does not depend upon optical or photographic methods, is capable of great accuracy, even when recording rapidly changing accelerations. The pressure upon the stylus is extremely light, and the celluloid flows plastically under the rounded point of the stylus, the line produced having such optical characteristics as to render any point on an enlarged image of the diagram readable to a high order of accuracy. A wide range of accelerations can thus be successfully recorded. The moving parts of the instrument are made small and arranged to move through small distances, so that slowly or rapidly fluctuating accelerations of small or considerable magnitude are recorded accurately and undisturbed by instrumental inertia effects. Two

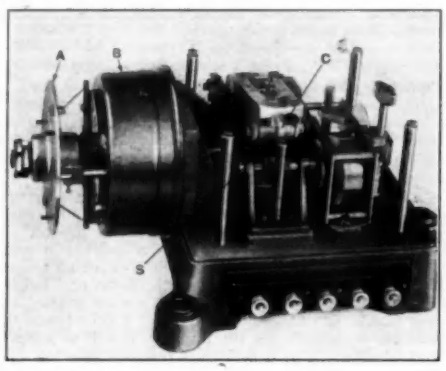


FIG. 6—ROTATIONAL ACCELEROMETER

electromagnetic marking mechanisms are fitted, so that a time scale, generally tenths of a second, can be marked on the film by one mechanism, while the revolutions of the engine or other shaft under test can be recorded by the other mechanism. In each case this is done by means of a separate stylus operating on the back of the film, so that it is possible for the stylus making the record of accelerations to pass over the whole of its range without fouling either the time-marking or the revolution-recording stylus. The instrument can be set in operation and the film speed adjusted electrically from a distance. The records are durable, as they cannot fade, and are impervious to the action of oil or water. The lines forming a diagram are clearly defined, and will bear considerable magnification. They can be examined at once by means of a suitable microscope or direct enlargements can be obtained by photographic methods, by a camera lucida, or by projection upon a screen and tracing. A convenient enlarging camera and a light and portable microscope designed to facilitate the examination and enlargement of the records are supplied by the Cambridge Instrument Company. The length of celluloid film provided is sufficient for the production of a large number of records while a new strip can be easily and quickly inserted in the instrument. The sensitivity of the instrument is such that from a record taken on a twelve-cylinder engine, for example, the relative work done by each cylinder can be readily seen and its performance analysed.

An extensometer for testing paper under varying humidity conditions—see Fig. 7—another of the Cambridge Instrument Company's exhibits, enables the expansion or contraction of samples of paper under varying humidity conditions to be accurately measured. It comprises a metal box with a removable plate-glass lid, and fitted with an air inlet and outlet, by means of which a stream of air can be passed through the closed box. A microscope is mounted above the glass plate on guide rods, along which it slides in a transverse direction, while it can also be moved longitudinally by means of a micrometer screw. Ten strips of sample papers are mounted within the box under slight tension which can be adjusted by movable weights. The box is closed and a stream of dry air passed through, which thoroughly dries the samples. An external lever is then operated, which makes ten needle points—one under each strip—rise and perforate the strips, and afterwards depresses the points clear of the paper. The microscope is sighted on the centre of the perforation in each strip in turn, and the zero—dry—position set on the micrometer head. Air of different humidity values is passed through the box, and the microscope again sighted on the perforations, so that new readings give the expansion of the samples under these conditions. A hair hygrometer of special design is used to determine the various humidity values. A motor-driven fan ensures that the air is efficiently circulated in the box during a test and

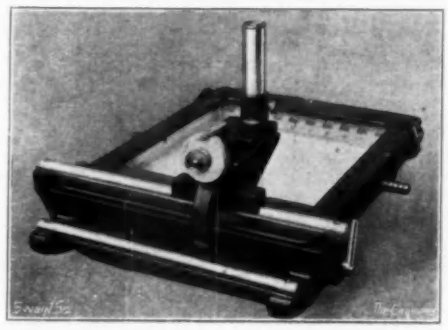


FIG. 7—EXTENSOMETER FOR PAPER

changed before the next test is made. The extensometer is shown by the courtesy of Brittains, Ltd.

The outstanding feature of the multipoint draught indicator shown in Fig. 8, which was exhibited among other things by Electroflo Meters Company, Ltd., is that the indicating scales are composed of illuminated milk glass. Pointers move up and down these scales in accordance with the draught or pressure transmitted to the instrument, so that in effect a curve is formed which gives the draught at a number of points. The instrument operates on the oil bell principle, and is extremely sensitive to small changes in draught and pressure. An incidental feature of advantage is that each movement is fitted with a zero adjuster, which is operated externally.

An apparatus for visual indication of acoustic characteristics of loud speakers was exhibited by the engineering laboratory of the B.T.H. Company. It is very necessary, when conducting research on the characteristics of different forms of loud speaker, to make a definite record of the acoustic characteristics, so as to be able to compare the results obtained by varying different factors in the design. Although it is true that the ultimate test of a loud speaker must be made by the musical ear, it is not always possible to obtain uniform results by this means in a laboratory. The apparatus has been in use in the engineering laboratory of the British Thomson-Houston Company for some time, and has been found very valuable for comparing quickly different types of loud-speaker movements, diaphragms, cones, &c. The acoustic characteristic of the loud speaker under test is obtained in the form of a curve connecting sound energy out-

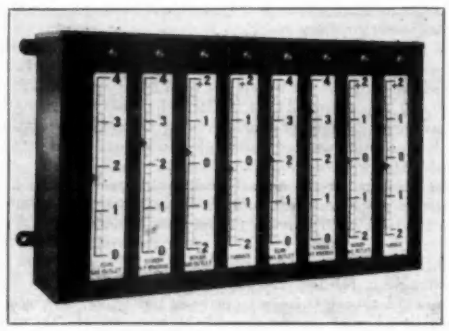


FIG. 8—MULTIPOINT DRAUGHT GAUGE

put as ordinate with frequency as a base line, the frequency ranging from zero to 10,000 cycles per second.

The loud speaker to be tested is placed within a cabinet, the walls of which are lined with suitable material to cut down the reflections as much as possible. A condenser microphone is placed in front of the loud speaker and connected to a multi-stage amplifier having known characteristics. The output valve of this amplifier operates a special type of hot wire galvanometer, the mirror of which is deflected round a horizontal axis through an angle proportional to the power delivered to the hot wire. A beam of light reflected from this mirror, therefore, traverses on a screen a vertical distance, which is proportional to the acoustic power which reaches the microphone. The loud speaker is fed through a power valve of such size and constants as is usually employed for the loud speaker in question. The grid of this valve is fed at constant voltage but varying frequency, from a heterodyne oscillator, which is controlled by a variable condenser. The design of this oscillator is such as to give practically constant voltage from a frequency very nearly zero up to 10,000 cycles per second. The variable condenser which controls this frequency is coupled to a mirror pivoted round a vertical axis, which deflects the spot of light on the screen along a horizontal line. The combination of the two movements of the beam of light, therefore—*i.e.*, the vertical movement corresponding to the microphone output, and the horizontal movement corresponding to the impressed frequency—trace on this screen a curve representing the energy response of the loud speaker to the varying frequencies impressed upon it.

The arrangement usually adopted is to place against the wall a large sheet of drawing paper and to dot in with a pencil various points on the characteristic as they are successively obtained by small increases of the applied frequency. Such a curve shows very clearly any resonances which occur in the loud speaker. It also shows the variation of the response as between the low frequencies and the high. By varying the design of the loud speaker and taking a number of such curve the main effects of different changes can be very quickly ascertained. The apparatus greatly facilitates experimental work on loud speakers, since the effect of a change in construction can be immediately observed without laborious meter readings or the plotting of curves.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

LOW-TEMPERATURE CARBONISATION.

SIR,—Your issue of December 14th, 1928, contains an article by John B. C. Kershaw, F.I.C., on the results of the Maclaurin smokeless fuel plant at Dalmarnock, in which, after reviewing the revenue and expenditure accounts of the smokeless fuel plant appearing in the Corporation Gas Department's accounts, he says: "It would be interesting to ascertain how Mr. Maclaurin proposes to distribute the gas at a rate to manufacturers of 1·1d. per therm." This figure of 1·1d. arises from the Glasgow Electricity Department having stated that gas at 1·1d. per therm would be of interest to them for boiler firing. To meet the Electricity Department's requirements the gas would have been manufactured adjacent to the electricity power station.

My estimate of the cost of manufacturing gas as given in my paper to the Manchester Smoke Abatement League in 1925 was 1d. per therm, so that I have to reconcile this estimate with the published balance sheets of the Glasgow Corporation.

The estimates given by me in this paper are the results anticipated for Dalmarnock when carbonising 36,500 tons of coal per annum and are as under:—

Revenue.	£	Per ton of coal. s.	d.
Coke, 20,078 tons at 28s. 6d. ..	28,606	15	8½
Oil, 569,400 gallons at 5d.	11,862	6	6
Sulphate of ammonia, 282 tons at £7	1,974	1	1
Gas, 2,190,000 therms at 1d. ..	9,125	5	0
	£51,567	.. 28	3½
Expenditure.			
Coal, 36,500 tons at 20s.	36,500	.. 20	0
Labour and supervision	2,737	.. 1	6
Rent, rates, taxes, &c.	2,737	.. 1	6
Repairs, stores and general charges	3,593	.. 1	11½
Interest and depreciation	6,000	.. 3	4
	£51,567	.. 28	3½

With these figures in front of us it is comparatively easy to see where the differences arise. The first item in the accounts which differs is the cost of coal, which averaged in 1926–27 26s. 6d. and in 1927–28 18s. 1½d. My estimates of prices for coal, oil and gas are all made using 20s. as a basis price for coal.

Taking oil next, we find that in the two years 1926–28 the sum credited for oil and liquor per ton of coal, viz., £4770 in 1926–27 and £4585 in 1927–28, works out at 7s. 10d. per ton of coal, which is 3d. per ton more on those two items than my estimates, and this in face of the fact that the profit on ammonia is only taken at 30s. 4d. per ton in place of £7 per ton as allowed by me in 1925.

The revenue for the Kincole, however, on the two years' totals only £13,071 13s., equal to 11s. 4d. per ton of coal carbonised in place of the 15s. 8½d. estimated. The Kincole was actually sold at a lower average price than the coal it was made from, in place of a higher price. This, however, I will return to.

Turning now to the expenditure side we find that in 1927–28 the figures compare with my estimates as under:—

	s.	d.	Maclaurin's 1925 estimate. s.	d.
Coal	18	1	.. 20	0
Wages	4	8	.. 1	6
Rent, rates and taxes	3	2½	.. 1	6
Interest and depreciation	5	7	.. 3	4
Repairs, stores and general charges	3	5	.. 2	0
	16	10½	.. 28	4

These figures look very damaging until they are more closely examined.

The first point to recognise is that my estimates were based on a throughput of 36,500 tons per annum, whereas the actual throughput was only 13,482 tons, or a little over one-third of the possible. This low throughput was partly due to the difficulty of disposing of Kincole, partly to the gasworks not having an outlet for more gas, and partly to a shut down for alterations in the gasworks not connected with the Maclaurin plant, but during which stoppage a second bench of retorts was fitted for gas firing. The item for wages is on this account very high, as the same number of men could have dealt with at least double the throughput.

The carbonising wages at Nuneaton for October, for example, work out at 2s. 2d. per ton of coal carbonised. This plant has only about one-fifth of the capacity of the Dalmarnock plant, but it has been working much nearer to its rated throughput. At full load I see no reason why Dalmarnock wages should exceed my estimate.

The next two items, viz., rent, rates and taxes and interest and depreciation, present no difficulty. With a throughput of 36,500 tons of coal in place of 13,482 tons both of these items will definitely come below my estimates, and the same will hold good for repairs, stores and general charges. For example, a steam engine capable of running a plant of double the capacity of the present one has been running at about one-fourth of its load. This means a very much heavier steam consumption per ton of coal carbonised than necessary.

It is not necessary for me to justify the yields of by-products estimated by me as these have all been exceeded, and Mr. Kershaw gives the yields in his article. I will therefore now deal with the sale of Kincole and the price obtained for it.

It is evident that Mr. Kershaw's visit to Glasgow must have been earlier than October, as all that he says regarding Kincole was in the main a true statement of the position up to that date. Kincole was not selling as freely as it was hoped. Since October the position has changed entirely. At the present time Kincole is rationed out to the coal merchants in rotation. Supplies to all the Corporation departments have been stopped so that the domestic consumer can get supplies. Persons residing outside the city boundaries cannot obtain deliveries except as a favour. Why this change? It is difficult to account for. The fuel is not any better than it was in 1927–28, though it is probably better than in the autumn of 1925. There is only one explanation known to me and it is this: Kincole, like all other smokeless fuels, gives more heat per hundredweight than coal and it has taken a longer time for the housewife to recognise its merits than I suppose any of the enthusiasts for smokeless fuel anticipated. What the Corporation returns will show from smokeless fuel next year I cannot say, but it cost me 30s. per ton in truck at Dalmarnock in October. The price in hundredweight bags, I believe, is 2s., and at this price the housewife is now anxious to purchase. The sale is not a fancy sale to faddists, but it is being sold very largely in the working-class districts of Glasgow. The Corporation have had a very difficult task in developing this market for smokeless fuel, as they had in the initial stages to supply Kincole in hundredweight bags to householders at considerable distances from Dalmarnock. The coal merchants with a few exceptions did more to hinder than encourage the sale, but the prejudice and conservatism seems at last to have been definitely overcome.

Returning now to the balance sheet, let me set down various items as they would work out with the plant working to its rated capacity. We then get the following:—

	£
36,500 tons of coal at 20s.	36,500
Wages at 2s. 2d. per ton on basis of Nuneaton ..	3,954
Rent, rates and taxes as charged	2,191
Interest and sinking fund as charged	3,413
Repairs, stores and general charges at ½ more than charged	3,422
	£49,480

Revenue.

Oil and ammonia at average of the two years 1926–27, 1927–28, viz., 7s. 10d. per ton	14,296
Gas at 1d. per therm = 5s. per ton	9,125
Solid fuel by difference, 19,345 tons at 26s. 5d. ..	26,059
	£49,480

The objective of the Glasgow Corporation was to produce a smokeless fuel that could replace coal on a heat-for-heat basis, and this, so far as the chemist and engineer are concerned, can now be accomplished.

The Corporation have borne the burden of creating the demand for the fuel which must precede the making of the city smokeless. The ability to produce gas at a cost of about 1d. per therm makes gas a possible fuel for steam raising. When gas is cheap enough for steam raising it is cheap enough for all other purposes. This, therefore, gives the Corporation another powerful weapon with which to work its way to the smokeless city.

The crepitation of the fuel made from certain coals requires further elucidation, but from numerous experiments made by me I am convinced that water held in some way in the pores of the fuel is the determining cause. In no case have I found a piece of sparking fuel which did not give off water when heated in a test tube. I have also found that a piece of fuel which crackles on heating ceases to crackle whenever all water is away, but on standing exposed to the air again is liable to crackle. I have a sample of wood charcoal, every little bit of which crackles violently when heated. This suggests that it is the presence of porosity similar to that of wood charcoal which gives rise to the trouble.

ROBERT MACLAURIN.

Stirling, December 20th.

WELDED STEEL OIL TANKS.

SIR,—We notice in your issue of December 21st a description of the erection of a large welded steel oil storage tank built in Australia. The wording of your article would rather infer that such articles have not been built in this country. For your information, therefore, we beg to enclose a photograph of one erected by us near Keadby Bridge on the river Trent last summer. We may say that this tank has proved so satisfactory that we have now

WELDED OIL TANK

received an order to build a very much larger one on an adjoining site.

We think you will be pleased to know that English firms are not behind in making the fullest possible use of modern methods of welding. The tank illustrated is 28ft. 2in. in diameter by 20ft. high with a ¼in. body and ⅜in. top. Its capacity is 250 tons and its weight about 18 tons. For test it was filled with water from the river Trent.

For and on behalf of ROBERT JENKINS AND CO., LTD.,
EDGAR J. JENKINS, Director.

Rotherham, December 27th.

CONSTRUCTION OF RAILWAY ROLLING STOCK.

SIR,—The publication of the proposed locomotive building programme of the London and North-Eastern Railway gives occasion for considerable surprise and anxiety to those who are familiar with the present deplorable position of the British locomotive building industry and with the cut-throat competition which is pursued in the desire to secure work.

I refer particularly to the announcement that the directors of the London and North-Eastern Railway propose that nearly 110 locomotives required by them shall be constructed in their own workshops, from which it would appear that little serious endeavour is evinced to effect real economies or to take advantage of favourable market conditions by such a large spending department of the railways as that which is responsible for the provision of the necessary rolling stock.

In a recent tendering for forty-four very heavy broad-gauge engines and tenders for the Indian Government Railways, the contract for which has been let at approximately £350,000, it is reported that the British prices were actually below those quoted by continental firms, notwithstanding the longer hours worked and the lower wages earned by the continental worker.

In addition to the actual saving obtained from a low contract price, railway companies in placing orders for rolling stock with private contractors benefit in that no payments are made by them until the rolling stock in question is completed and delivered, while in the case of construction by the railway companies themselves the Stores Departments have to provide materials, and wages have to be paid during the whole progress of the work through their shops.

There is also the larger question of keeping locomotive and carriage and wagon building establishments in active operation to enable them to compete in the markets of the world for orders for export to the ultimate benefit of the nation and of the railways themselves. The present extremely favourable opportunities of buying rolling stock in the open market under the most severe competitive conditions, and practically under cost, should weigh strongly with the financial authorities of the railways, alike on account of the companies' depleted resources and also because by observing such a course they would be following the example of the most efficient and up-to-date countries—the Continent and America—where, as a rule, all such new work is given out to competition.

Report has it that there are ample arrears of repair work available to keep the railway workpeople fully employed.

January 3rd. LOCOMOTIVE BUILDER.

LOCOMOTIVE DATA.

SIR,—It is becoming the custom when giving locomotive dimensions to state the cylinder and boiler horse-power, and such figures, at least in the case of the boiler, should be very useful. I do not recollect, however, ever having seen particulars as to how these are obtained. Is there a standard method of computation?

It would seem out of the question to estimate the output of a locomotive boiler on the basis of heating surface and grate area. Many boilers have a heating surface smaller than others that are of obviously less power. Also with grate area, the long shallow box entirely over the coupled axles, as in the case of the L. & N.W.R. 4–6–0 two-cylinder design has a larger grate, but considerably less volume than that of the short deep box of the same railway's 4–4–0 machine, and I think it will be agreed that the latter makes more steam. The volume of the fire-box would seem from both theory and practice to be the one quantity from which to estimate the output of the highly forced locomotive boiler, and yet this is the one figure that never seems to be given, and it is nearly impossible to arrive at it from published drawings. Cannot the powers that be be prevailed upon to include this figure when giving particulars of new machines? Of course, boiler horse-power to have any meaning necessitates the assumption of some standard engine efficiency.

As regards the cylinder horse-power, surely this is rather a meaningless figure. At high speeds it is quite dependent on the boiler, and at low speeds the full boiler power cannot be used, and it is only the tractive effort that matters. For example, the new L. & N.E.R. 4–6–0 is said to have a boiler horse-power of 1230. A short calculation will show that the cylinders, even in full gear, cannot develop this power below about 19 miles an hour. It would seem that there is very little to be gained by adding to the present tractive effort figures, but it would perhaps be advantageous to make allowances when the maximum cut-off is shorter than usual.

C. M. KEILLER.

Cookham Dean, January 7th.

WAGON TIPPLER.

SIR,—We note in your issue of the 28th a description of wagon tippler with special reference to the position of the driving and idle rollers, as though they were some novel feature in the position indicated. All our tipplers have had driving and idle rollers in the positions indicated for over fifteen years.

Per pro NORTONS (TIVIDALE), Ltd.,
BERTRAM NORTON, Governing Director.

Tipton, Staffs., December 31st, 1928.

GAS DISTRIBUTION IN GERMANY.

COALOWNERS in Germany are apparently quite satisfied with the practical character of the scheme they are carrying out for the distribution of gas over the greater part of the country. Already an extensive system of mains is being laid down from the Ruhr and Westphalia towards Hanover, with extensions later on to Berlin and Leipzig. The scheme involves the laying of similar mains from Lower Silesia and other coalfields, and if it be found that lignite gas is suitable for the purpose, it will be included in the distribution by a system of mains which will cover practically the whole of Germany. As the municipal gas undertakings refuse to associate themselves with this colliery enterprise nearly the whole of the gas will be distributed for industrial purposes. The principal main from the Ruhr is of wrought iron, with a diameter of 32in. and a thickness of a little less than ⅜in. The pressure is 3 atmospheres. The main starting from Dortmund towards the south has a diameter of 28in. and a thickness of ⅜in. As the distance increases there is a diminution of diameter and an augmentation of pressure, which is from 8 to 10 atmospheres at Dortmund, and at Hamm the diameter is 16in. and the pressure 15 atmospheres. It is stated that the pressure will be raised to 25 atmospheres. The work being carried out by the German collieries is not an experiment but an enterprise involving a huge expenditure of capital, and there is nothing yet to prove its ultimate success. French experts affect to believe that this success is by no means assured, and they ask what will be done with the coke, unless it is used for the production of water gas. It can hardly be transported over long distances in competition with coke from the local gasworks. The whole scheme has necessarily been thoroughly worked out as regards the utilisation of the coke, as well as by the by-products, and its operation will be watched with considerable interest.

BOOKS RECEIVED.

The Broken Trident. By E. F. Spanner. London: E. F. Spanner, 9, Billiter-square, E.C. 3. Price 2s. 6d. net.

A.O.B. Werkzeugmaschinenblätter. Berlin: Beuth-Verlag G.m.b.H., Dresdenerstrasse 97, Germany. Price 9 marks.

About Airships: Written for the Man in the Street. By E. F. Spanner. London: E. F. Spanner, 9, Billiter-square, E.C. 3. Price 6s. net.

Précis de Construction, Calcul et essai des avions et hydravions. By J. Guillemin. Paris (VIe.): 55, Quai des Grands-Augustins. Price 100f. net.

All the World's Aircraft, 1928. Edited by C. G. Grey. London: Sampson, Low, Marston Company, Ltd., 100, Southwark-street, S.E. 1. Price £2 2s. net.

Cantor Lectures on Fatigue Phenomena, with Special Reference to Single Crystals. By H. J. Gough, M.B.E., D.Sc. London: The Royal Society of Arts, John-street, Adelphi, W.C. 2. Price 3s. net.

The South and East African Year Book and Guide for 1929. Edited by A. Samler Brown and G. Gordon Brown. London: Sampson Low, Marston Company, Ltd., 100, Southwark-street, S.E. 1. Price 2s. 6d. net.

Railway and Road Matters.

HITHERTO the only services to Belfast on Sunday nights have been those *viâ* Holyhead and Stranraer, and the only service on Sunday nights from Belfast has been by Holyhead. Beginning on Sunday, December 30th, there is now a service in both directions *viâ* Heysham.

IN this column of our issue of May 11th last, it was intimated that Mr. J. Briggs, the then district engineer for the Derby, Southern, division, London, Midland and Scottish Railway, had been removed to the Bangor district to succeed Mr. W. E. Thornhill, who had been made Western divisional engineer at Crewe. It is now announced that Mr. E. H. d'E. Darby, of the Manchester, Exchange, district, has been transferred to Derby to succeed Mr. Briggs.

IT has been necessary, under the London Traffic Act, to elect a new London and Home Counties Traffic Advisory Committee. The new body came into office on December 1st and the list of members has now been announced by the Minister of Transport. Sir Henry Maybury is again the Chairman and Mr. J. S. Pool Godsel, of the Ministry of Transport, the Secretary. Sir Herbert Walker and Mr. Frank Pick are two of the four representatives of the interests of persons providing means of transport and users of mechanically propelled vehicles and horse-drawn road vehicles within the London traffic area.

IT is very unfortunate that after two bad years as regards railway accidents, the New Year was just over a week old when there was another fatal passenger train accident. As the mail, on Tuesday evening last, from Bristol to the North, on the London, Midland and Scottish Railway, was near Ashchurch it ran into a goods train and two passengers, a company's servant travelling as a passenger, and the driver of the mail were killed. At the time of writing the cause has not been publicly revealed, but it would appear as though the foggy conditions that have prevailed this week were a contributory factor.

A MINOR accident outside London Bridge Station about seven o'clock on Thursday, December 27th, caused considerable inconvenience to the travelling public, inasmuch as the Central, or Brighton, Station had to be entirely closed until the afternoon. An empty carriage train came into slight collision with a passenger train, whereby a coach was derailed. That vehicle unfortunately struck one of the standards of the overhead electrical equipment and brought down a girder, into which obstruction a passenger train ran. We believe that, although those standards have been in use on the Brighton section for some fifteen years, this was the first such mishap to them.

THE Ministry of Transport railway statistics for September last have recently been issued as a Stationery Office publication, price 3s. 6d. They show that, compared with the corresponding month of 1927, there was an increase of 0·94 per cent. in the number of passenger journeys which was accounted for by an increase of 28·26 per cent. in those carried at reduced fares in contrast with a drop of 14·55 per cent. in those carried at full fares. The passenger receipts also rose by 1·24 per cent., of which 24·65 per cent. increase came from reduced fares, as against a fall of 14 per cent. in the full fares. The increased passengers were carried by a corresponding increase—0·9 per cent.—in the passenger train mileage. The tonnage of goods traffic decreased by 9·85 per cent., of which decrease 10·16 per cent. was in general merchandise, and there was a fall of 9·86 per cent. in the goods train receipts. As a set-off there was a saving in goods train mileage of 7·55 per cent.

IT comes as a surprise to hear, from a semi-official statement of the London and North-Eastern Railway that 140 powerful motor lorries would be working in London by the end of last year, and that the opening of the present year would see a total fleet of 500 motor vans. One of the remarkable things in connection with the development of the use of motor vehicles has, to our mind, been the slow progress they have made on the railways. In 1924 the companies had 32,422 horse-drawn goods vehicles and 2127 motor driven; in 1927 the corresponding figures were 32,498 and 2873. On the London and North-Eastern there were, in 1924, 6930 horse-drawn and 198 motor driven; in 1927 the figures were 7516 and 322. It is not only remarkable that motors replace horses so slowly, but that, in these bad times, there is an actual increase in the number of horse-drawn vehicles. Moreover, the number of horses has only fallen by 81 since the total of 18,793 in 1924. The probable reason is to be found in the long periods for which the vehicles are standing.

THE report of Lieut.-Colonel Mount on the fatal collision of October 9th at New Tredegar Colliery, on the Brecon and Merthyr section of the Great Western Railway, was issued on January 4th. Owing to a slip on the down side of the line, all trains were being worked for a distance of 270 yards over the up line. The signals were suitably interlocked, so that the up and down home signals could not be at "clear" simultaneously, and the signalman had instructions not to accept opposing trains. The man on duty on the evening in question accepted, however, a down colliers' train and lowered his signals for it, and then, before it had arrived, he accepted, at full line-clear, an opposing up passenger train. The driver of the latter, unfortunately, overran the signals and the two trains met, head on, on the single line. Colonel Mount passes some severe criticisms on the signalman, of whom he said that "his evidence showed that he was no novice, and in its untruthfulness it merely emphasised his unreliability, lack of self-discipline, and that sense of responsibility which are so essential and fortunately usually found in signalmen." Of the erring driver, Colonel Mount says that whilst he can by no means be relieved of blame for transgressing his first and foremost duty, it would be unfair to disregard entirely the likelihood that he was experiencing at the same time some measure of difficulty in regard to the operation of the train and to his view ahead. Whilst remarking that it might be assumed that automatic train control would have prevented the accident, the report made the important qualification, "if, indeed, provisions of such apparatus on a line of this character and under such speed conditions were ever to be contemplated."

Notes and Memoranda.

TWENTY-TWO farms and ranches of various types have been selected by the Texas Committee on the Relation of Electricity to Agriculture upon which to make intensive scientific experiments in farm electrification. This is the first step in a three-year programme to determine how electricity can best be adapted to Texas agriculture. The farms are in various parts of the State and represent several types of farming, such as dairy, poultry, general, cotton, truck and ranch.

IN a paper read before the Institution of Engineers, Australia, on the subject of rural electrification, Mr. J. R. Brookman said that the power factor of such supplies was generally not much more than 50 per cent. Supplies to pumps for irrigation purposes would, he said, help to improve matters, as that demand would then fall off in dull weather, when the requirements for lighting increased. The author also said that the electrical demands of a farmer working 800 acres or so produced only about one-third of the revenue received from a market garden of from 5 to 50 acres.

EXPERIMENTS on electrically heated kilns for use in the ceramic industries have been in progress for the last ten years, but it is only recently that improvements have been made which promise that they will be useful in commerce. A reduction in the price of electricity would widely extend its use for furnaces. The great purity of the atmosphere in an electric furnace makes it ideal for decorated pottery. A normal coal-fired muffle furnace requires about nineteen hours before a satisfactory result can be obtained. According to S. R. Hind in *World Power* for December, better results can be obtained in half the time by an electric furnace. The exceptional accuracy with which the temperature of the furnace can be controlled and what may be called the "availability" of the energy as compared with that obtained from fuels, leads to excellent results.

WE learn from the *Journal* of the Franklin Institute that an investigation on the thermal expansion of low-carbon iron chromium alloys of the "stainless iron" type was recently completed. No data on this subject were available. These alloys are being used to an increasing extent for various purposes such as parts of steam turbines, devices for handling acids, and in the manufacture of other articles that must resist corrosion. A scientific paper which gives results on the expansion of stainless iron for various temperature ranges between room temperature and 1000 deg. Cent. is now in press. Critical regions were located on some samples of stainless iron. This material expands about 17 per cent. less than pure iron for the temperature range from room temperature to 100 deg. Cent. The complete report will be valuable to persons interested in this material.

ACCORDING to the U.S. Bureau of Mines, the consumption of tin in the United States is so large that the annual imports amount to about one-half of the world's total production of that metal. As the result of a canvass made to ascertain the amount of tin consumed for different purposes in the United States during 1927, the Bureau found that 24,527 tons of primary or virgin tin were used in the manufacture of tin-plate and terne plate, or 35·65 per cent. of the total consumption of primary tin in the United States in that year. Next in order of magnitude as a consuming factor is solder, which required 13,734 tons, or 19·96 per cent. of the total. The manufacture of babbitt metal required 8705 tons, and foil and collapsible tubes consumed 6903 tons. The results of the Bureau's inquiry, wherein effort was made to eliminate figures relating to secondary tin, account for 68,797 tons of primary tin, a quantity equivalent to 96·7 per cent. of the imports in 1927. The results of this canvass, based on reports from 1050 concerns, are tabulated in Information Circular 6084.

EXPERIMENTAL demonstrations of electric lighting in Taunton date back to 1879, when the brilliance of an 1800 candle-power Serrin arc lamp, supplied from 50-quart size Bunsen cells, marked the dedication of the Masonic Temple. About the same time a football match was played in the park by the light of three Siemens arcs, surely the earliest example of football by electric light. According to "Distribution," published by W. T. Henley's Telegraph Works Company, Ltd., various demonstrations were made in following years. In 1884, for example, eight arc lamps were erected around the Parade, to the order of Mr. Massingham, a local boot and shoe manufacturer. The enterprise of this gentleman resulted in the erection of the first permanent station in 1885, and on Saturday, December 12th, fourteen Thomson-Houston 1200 candle-power arc lamps were supplied from one of the two thirty-light generators. The original consumers were all tradesmen, the Castle Hotel being the only premises where incandescent lamps were installed. Supply was given from dusk to 11 p.m. In 1886 a duplicate plant was installed, and a trial of seven 1200 candle-power arc lamps round the Parade was made.

PROBABLY the largest task which a public address system has ever been called upon to carry out, states the *Wireless World*, was on the occasion of the Eucharistic Congress in Sydney last autumn. The major part of the work, which was entrusted to Amplion (Australasia), Ltd., consisted of supplying music from a central source to a long procession covering a route through the city a mile and three-quarters in length. It was desirable that the procession, in connection with the carrying of the Host, should engage in choral singing. Synchronisation was necessary, and therefore sixty power loud-speakers were employed in four banks of fifteen at vantage points along the route. The band supplying the accompaniment was situated in the Domain. Here a microphone and Amplion Minor equipment were installed, the output being connected to a Senior amplifier. The first four outputs of the latter were fed to other Senior amplifiers, multiple wiring being used which allowed of a common feed. In practice it was found that only one-third of the maximum power was necessary to give ample volume to accompany the procession of singers. The batteries supplied 2000 volts, and the total current consumption was 22 ampères. The entire installation operated perfectly and was instrumental in conveying the sounds of the ceremony to a crowd of 150,000.

Miscellanea.

THE East London, South Africa, electric power plant is to be extended by the addition of two 25,000 lb. boilers and a 3000-kilowatt turbo-alternator.

IT is proposed to extend the water supply of Pretoria, so that it may have a capacity of 10,000,000 gallons a day. The cost of the scheme is put at some £800,000.

ACCORDING to the latest reports the new Titan crane ordered for the extension of the breakwater at Durban should now be in commission. There is a stock of 800 blocks of concrete, each of 30 tons weight, in readiness for laying.

THE number of patent applications filed during the past year reached the record total of 38,593, an increase of 3124 over the year 1927, and was the largest ever taken out in one year, the preceding record being in 1920, when 36,672 patent applications were filed.

IN accordance with the wishes expressed by members during the fifth annual Conference at Oxford arrangements have been made for the next Conference of the Association of Special Libraries and Information Bureaux to be held at Trinity College, Cambridge, during the week-end commencing Friday, September 20th.

IT is reported that the sugar beet factory at Norton Fitzwarren, near Taunton, is being equipped to deal with 25,000 tons of beet by the Oxford drying process during the 1929 season. This will be the first factory in the world outside Oxfordshire to adopt the new process, which was discovered by a young Oxford scientist, Mr. B. J. Owen, and perfected by him at Eynsham. This development will relieve growers in Somersetshire, Wiltshire, Gloucestershire and other parts of the south-western area from difficulties regarding carriage.

THE Ontario Hydro-Electric Power Commission has decided to add a tenth unit to the Queenston power development of its Niagara system, increasing its capacity by 65,000 H.P., and bringing the total capacity up to 625,000 H.P. The cost of the additional unit will be about 4,000,000 dollars. Although the station was originally designed for only nine units, it has been demonstrated that there is a sufficient flow of water in the canal from Chippawa Creek to operate the extra unit. While no additional work will be required on the canal itself, it will most likely be necessary to enlarge the forebay on the north side, and put in an additional penstock.

THE construction of the Lake Cabonga Dam on the Gatineau River has been begun by the Gatineau Power Company. The new dam, which will store the water from Lake Cabonga, and will form a reservoir with a capacity of 45,000,000,000 cubic feet, is situated 46 miles above the Mercier Dam. The combined storage capacity of the two reservoirs will be 145,000,000,000 cubic feet. The Gatineau Power Company has three hydro-electric power plants on the river. Two of them are within six miles of Ottawa, and have a combined designed capacity of 290,000 H.P., while the third station, which is 35 miles north of Ottawa, and is at present generating 80,000 H.P., has a designed ultimate capacity of 204,000 H.P. The steady operation of these plants is expected to be greatly facilitated by the new storage dam.

THE Consolidated Mining and Smelting Company, Ltd., is installing at its works at Trail, B.C., an electric steel plant, the first unit of which will have a daily capacity of 10 tons of high-grade steel. It will be the first steel plant in Western Canada. It is understood that the company intends to produce only the higher priced grades of steel for the present. Iron ores from the plants of the Consolidated in the neighbourhood of Trail, at present discarded as waste, in connection with the production of lead and other metals, will be used as raw material for the steel plant. The installation has been delayed for some time, because of the lack of surplus electric power in the Kootenay, but new construction plans, adopted during the past year by the West Kootenay Power Company, will now provide an adequate supply of power.

THE Canadian Department of Marine and Fisheries has entered into a contract with the Foundation Company of Canada for reinforcing the supports of the King Edward Pier in Montreal Harbour, which are giving way. One hundred and forty steel cylinders will be sunk outside the existing supports, and the intervening space will then be filled with crushed stones. The top of each cylinder will be covered with a concrete coping, and the whole will be brought to the level of the present shed floor, which will be extended to the new portion of the pier. The whole work, it is understood, will call for an expenditure of over 500,000 dollars. The undertaking is in the nature of an experiment, in view of the same method being adopted for the improvements of other piers which are now under consideration. The work, which could not be undertaken during the season of navigation, will necessarily be much more costly owing to its having to be undertaken during the winter. Dredging will also be carried on in the basin, and it is expected that a minimum depth of 35ft. will be attained before the opening of the season.

PORT EDGAR naval base at South Queensferry, which fulfilled an important purpose during the critical days of the war, is to be put up for sale by the Admiralty as it is no longer required for naval use. The Port Edgar base, which is on the south shore of the Firth of Forth, almost opposite the great naval base at Rosyth, was the home of the destroyers and other light craft of the Navy during the war. It was an emergency war product, and it sprang up in mushroom-like fashion in order to meet the needs of the fighting fleet. A large basin was constructed to accommodate the small ships, while workshops and establishments for naval stores quickly came into being. When the Grand Fleet was ultimately stationed in the Firth of Forth the bulk of the repairs and refitting of the smaller fighting ships was carried out at Port Edgar. About two years ago, when it was first intimated that the Admiralty had decided to close the base, efforts were made to keep it in active service. The present decision involves a serious increase in unemployment in South Queensferry, a small West Lothian burgh, which came into considerable prominence during the days when the Grand Fleet was stationed in the Firth of Forth.

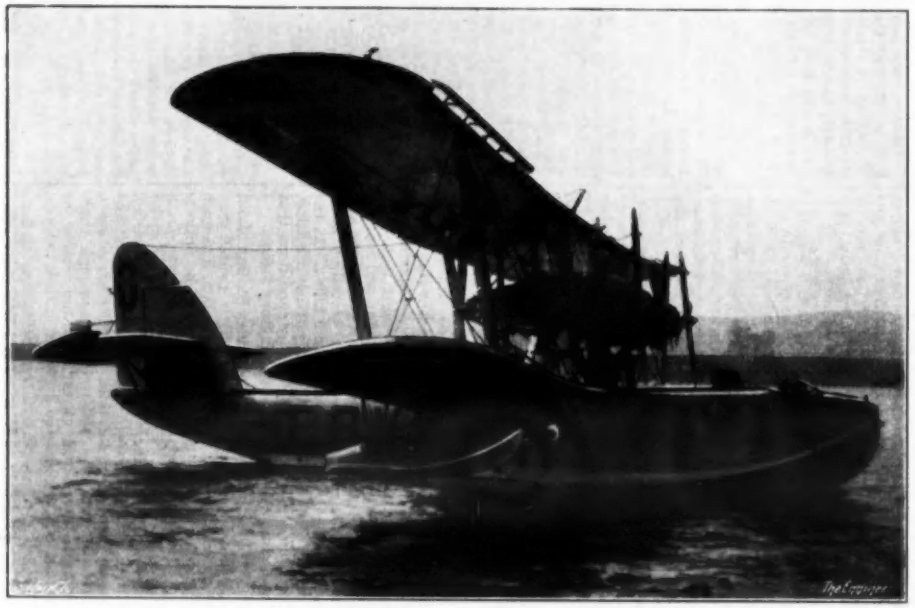
SOME BRITISH AEROPLANES OF 1928

(For description see page 34)

PARNALL "IMP" TWO-SEATER LIGHT AEROPLANE

ARMSTRONG WHITWORTH A.W. 14 SINGLE-SEATER FIGHTER

GLOSTER "GOLDFINCH" ALL-METAL SINGLE-SEATER FIGHTER



SHORT BROS. "CALCUTTA" FLYING BOAT WITH SLOTTED WINGS

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DEATH.

DECEMBER 28th, WILLIAM THOMAS EDWARD BARKER, Technical Director of David Rowell and Co., Ltd., of 14, Howick-place, Westminster, S.W. 1.

THE ENGINEER.

JANUARY 11, 1929.

The Production of Steam Tables.

The energy with which the American Society of Mechanical Engineers is pursuing its investigations into the properties of steam is an example to all bodies engaged in research work. The Steam Research Committee of the Society, under the chairmanship of Mr. George Orrok, directs and co-ordinates the work carried out in four of the principal physical laboratories of the United States, each of which has made itself responsible for some particular contribution to the knowledge of the properties of steam. This method of team work has not only the great practical advantage of producing results more quickly, but by the opportunities for cross-checking, which it frequently gives, it reduces the likelihood of systematic errors. For some years past it has been the custom to publish information concerning the progress of the work in the *Mechanical Engineering*, the official organ of the A.S.M.E., and the tradition is maintained in the December issue. This time the principal contribution takes the form of a new Mollier diagram ranging from 0·2 lb. per square inch to the critical point and including temperatures up to 1000 deg. Fah. There is, in addition, a table giving the specific volume of saturated and superheated steam up to the same temperature and up to 3500 lb. pressure. These do not appear as official communications of the Committee, but are given under the signature of Mr. J. H. Keenan, now Assistant Professor of Mechanical Engineering at the Stevens Institute, and formerly turbine engineer to the General Electric Company. Their publication, however, under the auspices of the A.S.M.E. gives them to a certain extent an official value and tends, we think with regret, to render more difficult the production of a set of steam tables which will be internationally accepted.

The importance of ensuring international agreement as to the figures to be used in steam calculations, at all events where the principal engineering countries of the world are concerned, is too evident to need enlarging upon. For each country to have a set of steam tables of its own would be almost as bad as to admit that the values of atomic weights or specific gravities might be different according to the nationality of the person using them. We all want our physical constants to be of the very highest precision obtainable, but we want, at least equally, that computers of all countries shall be in agreement as to what values are to be taken. At the recent World Power Conference the note which dominated almost every discussion was the necessity of international standards of testing, of recording data, of specifying performances, and so on. During the Congress Mr. George Orrok gave the public assurance that the American and British workers on the properties of steam had agreed to refrain from publishing any official figures until both parties were satisfied with them. Mr. I. V. Robinson confirmed this and added that the agreement extended, not only to British and American investigators, but that the Germans and Czeckoslovakians had bound themselves by the same promise. It is, we believe, in accordance with this understanding that the B.E.A.M.A. Committee has not published the new tables computed by Professor Callendar, which extend up to a pressure of 4000 lb. per square inch and embody the results of actual experimental work at pressures of this order. Had Mr. Keenan shown a similar reticence, although we should have been, at least temporarily, deprived of the fruits of his work, the present confusion would not have been made greater by the appearance of a fresh set of figures which it would be wrong to take as representing the last word to be said on the properties of steam. In the circumstances it is desirable that the publication of Professor Callendar's tables should not be unnecessarily delayed, and we are glad to learn that the early publication of them in a summarised form is in contemplation.

The new Mollier diagram now put forward measures 50 cm. in the direction of entropy by 80 cm. in the direction of total heat. It is excellently proportioned and of a really practical design, the lines of constant pressure, constant volume, temperature and dryness being on a background so divided as to render the use of the diagram easy without recourse to scales or set-squares. Heat drop, also, is measured vertically downwards in the natural and sensible way, instead of sideways and from right to left, as in the British Mollier diagram of the B.E.A.M.A. For some reason, however, the American diagram is printed throughout in yellow ink, which detracts greatly from the comfort of using it, especially in artificial light. The idea is possibly to render pencil marks made upon it more legible. The table of specific volumes which accompanies it has the defect that the volumes are tabulated under degrees of superheat instead of under the actual temperatures of the steam. Years ago, when steam pressures were uniformly low, there was a certain meaning in the statement that the steam was superheated by so many degrees, but these times have passed. It is the actual temperature, not the degrees of superheat, with which the engineer is really concerned. A steam temperature of 600 deg. Fah., for example, corresponds to a superheat of about 300 deg. in the case of steam at 70 lb. pressure, whereas the same temperature would mean a superheat of little more than 150 deg. Fah. with steam at 400 lb. pressure. A steam table, to be of the greatest use, must tabulate the properties of steam against actual total temperatures, as is done, for example, in Callendar's tables. The user of the tables can readily find out for himself how many degrees of superheat this temperature corresponds to for the particular pressure concerned, should he have any interest in so doing. The method of tabulation adopted by Mr. Keenan makes direct comparison with Callendar's tables almost impossible without interpretation, except in the one case of steam at 1000 deg. Fah. For this temperature, and a pressure of 1500 lb., Callendar gives the specific volume as 0·563 cubic feet per pound, as against 0·5298 cubic feet suggested by Mr. Keenan. The difference is a matter of nearly 6 per cent., which increases to nearly 8·5 per cent. for steam at 2000 lb. pressure, Callendar's volume for this pressure being 0·419 cubic feet and Keenan's 0·3846 cubic feet per pound. At low pressures and temperatures the volumes given by Keenan are in excess of those of Callendar.

It is not for us to decide to which tables the greatest credence should be given. We can only regret that they differ. Both authorities start from experimental data extremely difficult to obtain accurately, notwithstanding the well-equipped laboratories at their disposal. Both have then to develop formulæ from which tables can be computed, and to take care that these formulæ are consistent with the thermodynamic relation-

ships which exist between the various properties of steam. The Americans, we think we are correct in saying, have confined their work to what may be called this purely empirical basis. Their object has been to ascertain facts as accurately as possible, to devise interconsistent formulæ which will represent the facts as closely as may be and then to go ahead. Callendar, as is well known, has been guided in his formulation by considerations of the molecular structure of steam. His formulæ had not only to represent facts and to be inter-consistent, but were also required to be intelligible when steam was regarded as made up of molecules with energy of translation and energy of spin, incompressible volume and a habit of co-aggregating to a greater or less degree in accordance with the conditions of temperature and pressure to which they are subjected. His equations are extremely simple and would indeed be almost elementary were it not for the expression which represents the reduction in volume of the steam due to co-aggregation. It is impossible to ignore the strength of a position which is fortified by apparently impregnable physical reasoning. Steam, we know, must be composed of individual molecules, and by experiment and inference we can become very sure as to how these molecules behave. The properties of steam must be due to the action of its component molecules, and no steam tables will be finally satisfactory unless they meet the theoretical requirements of the physical as well as the practical needs of the engineer. Callendar's recent demonstration that the generally accepted view of the critical state of steam was incorrect, and that when the conditions in the neighbourhood of the critical point were accurately observed his equations would be found to hold right up to that point, has been of immense support to his theory. It is indeed a matter of outstanding importance to those concerned with the properties of steam, for it was just at these high pressures that his theory was most open to objection on the grounds that it did not agree with facts. Now that the facts are shown to be wrong the case is altered. This is not to say that the existing edition of the Callendar steam tables is the most accurate set of tables we are likely to have. Indeed, as the investigation of steam at the critical point has shown, the irreducible molecular volume of steam is much less than the 1 cubic centimetre per gramme assumed when the tables were compiled. Why a molecule of steam requires less space to exist in than the same molecule in the form of water is not very clear, but it appears to be content with something like one-sixth the amount only. Since the molecules are so very minute in comparison with the total volume occupied by the steam, their actual volume is of little or no importance except when the pressure is very high. Nevertheless, the fact is one for the physicists to explain, and in doing so they will make a useful contribution to our knowledge. Meanwhile we must accept it as an experimentally determined fact, though subject, of course, to corroboration by other observers.

The Market for Engineers.

The highest definition of a profession is a vocation in life in which the object of making money is secondary to the satisfaction of rendering effective service. Judged by this standard, engineering ranks high among the professions, though engineers, like other professional men, have to sell their services in order to live. There are few engineers who have not had this fact brought home to them more or less acutely at some time in their career, but it is the young man endeavouring to get his first foothold on the ladder who realises it to the full. Every year brings thousands of recruits to the profession, mostly very expensively educated, and believing, in their enthusiasm, that their degrees and diplomas should ensure them a welcome and at least a reasonable salary. Disillusionment soon comes. They have entered the market with little or nothing of any commercial value to offer in exchange for the salary hoped for. An employer engages a man to do some definite kind of work, and what the man may know is of no concern to him, provided that he is capable of carrying out the job satisfactorily. Payment can only be earned by work, and not by knowledge. This may seem a hard saying, but a moment's reflection will show that it is true. It in no way denies the value of knowledge, but the value is a personal one to the possessor, giving him the possibility of a fuller and more enjoyable life and making him potentially a better man. Furthermore, of all the knowledge in the world, that gained from books and in academies of learning is the least valuable, for it is the easiest to come by. The pre-digested food of the class-room, which serves to answer examination questions, is the most ineffective kind of knowledge, and unfortunately it is this kind which enables a student who has never seen a workshop to put an engineering degree after his name and tempts him to believe that he really knows something about engineering.

The difficulties experienced by young men coming from engineering schools and colleges in finding employment are sufficient to justify a consideration of the situation. It is no good to say that employers are conservative, that they do not appreciate science, that they are jealous of superior knowledge, or that, in short, they do not know what is good for them. At any rate, they know what they want, which is the most important fact. They have the responsibility of conducting their businesses satisfactorily, and as it is they who pay the piper they have the right to call the tune. One way of judging the market for engineering services is to consult the advertisements by employers. A recent examination of one hundred and fifty such advertisements brought to light some rather significant facts. The object of the investigation was to discover to what extent education of the university type was called for, either directly or by implication. The advertisements were all taken in the order they appeared, none being omitted except such as referred to teaching appointments or to jobs as foremen and mechanics. Naturally, in such a collection, a large proportion were for men to fill positions to which no young man from college could possibly aspire. In such cases an attempt was made to estimate the relative advantages of an aspirant who had devoted the outset of his career to university studies, over one who had spent the formative years of his life in getting practical experience in works, supplemented by such study as can well be carried on simultaneously. The advertisements were classified in three groups, according to whether stress seemed to be laid on educational qualifications, practical experience, or both. When there was any reasonable doubt as to the class in which any advertisement should be placed, the benefit of it was given to the university training. The results were somewhat surprising. Eighteen of the advertisements were for Government or municipal appointments. Of these, four seemed definitely to call for university training, six laid more stress on practical experience, and the requirements of the remaining eight could not have been satisfied without both. The advertisements emanating from private employers numbered one hundred and thirty-two. In only five cases would the college graduate have certainly been given the preference, while in no less than one hundred and seven practical experience pertaining to the job was the only qualification demanded. For the other twenty a considerable amount of theoretical knowledge was clearly needed, but practical experience was also called for. In those cases one might probably say that either a college graduate who had been fortunate enough to acquire a good subsequent training in the works, or a man who during an ordinary apprenticeship had used his opportunities for study would equally have given satisfaction. The difference in the ideas of official bodies and private employers as to the relative value of academic and practical qualifications is very marked. It may perhaps be accounted for by the desire of officialdom to be above reproach with regard to a profession which it does not understand, or by the fact that public bodies have not the same incentive as private employers to get the best real value for their money. Since, however, the vast majority of appointments are made by private firms, their views, as deduced from their advertisements, are of the greater importance. They, as has been shown, have twenty-one vacancies for men with the sort of knowledge that is not to be gained in the class-room for every position where such knowledge is of special value. It is experience that counts, and the harder it is to gain, the more valuable it is. The constant recurrence of the word "experience" in the "Situations Vacant" columns of the technical journals should have its significance for those who wish to launch youths into the profession. It is experience that commands the market, and therefore it is experience which has to be got by those who would earn their living. The only way to acquire it is by practical work, shoulder to shoulder with men of the craft. The time to acquire it is in early youth, when life is an adventure and dirty hands and overalls create rather a feeling of pride than of indignity. The idea that "engineering is based on scientific knowledge" is both wrong and harmful, as it is generally understood. It puts the cart before the horse. We had bridges centuries before there was a theory of continuous girders or of redundant members, and steam engines years before there was any theory of thermodynamics. The screw propeller and the aeroplane both existed before their actions could be explained by the laws of hydrodynamics. It is almost universally so. Engineering is a constructive art, and the education of the engineer will be most successful if it follows the natural lines of evolution, namely, a knowledge of actual things before a study of the theories pertaining to them. Thus will judgment be formed which is the most valuable faculty an engineer can possess. Reasoning may be none the less accurate, if it cannot be expressed in the terms of a differential equation. Indeed, it may easily lead to more correct conclusions, for a practical engineer has to take into account the whole of the conditions, including those imponderable ones which can find no place in any formula.

We have given evidence that manufacturing firms are seeking men with practical experience, and the inference is that they have difficulty in finding a sufficiency of them. During the last quarter of a century this difficulty has been increasing, owing largely to the change in the methods of training. In this connection another fact should be considered. It is during the same period that British engineering has been marked by an increasing and disquieting dependence upon foreign design. It was hoped that the development of theoretical education of university standard would have enabled our designers to maintain the lead given by men who had no such facilities. Quite the contrary, however, seems to have occurred. The system of education under which a youth could obtain an engineering degree without necessarily knowing anything of the actual processes of manufacture or the operation of machines, has now had a considerable trial. Yet there is hardly a branch of mechanical engineering in which the start given by the practically trained engineers of a generation ago has not been followed by a depressing reliance upon foreign designs. It is no answer to this to retort that the importance of theoretical knowledge is even more emphasised on the Continent than in England. The conditions there are different, the men are different, and the education is different. What we are concerned with are the conditions at home, and he would be a bold man who could assert without reserve that the system under which the majority of young men attempt to enter the profession to-day is productive of the kind of engineer who completely satifies the requirements of employers.

SIXTY YEARS AGO.

A glimpse of life in the British Navy sixty years ago is contained in a paragraph in our issue of January 8th, 1869, dealing with a cruise of the Channel Fleet ironclads to Lisbon. The fleet left Plymouth under steam on November 26th, and for two days experienced fair weather. On the 28th, however, the barometer fell considerably, and as there was every appearance of an approaching gale, the Admiral ordered all ships to bank their fires and proceed under sail. The reason for this order was stated to be the desire to have steam power available in case of emergency, but we feel tempted to believe that it was really dictated by the distrust of steam in bad weather, which the sailor still felt, and his abiding faith in sails. "The wind being foul," the statement continues, "the squadron had to perform the evolution of beating to windward." On this point of sailing the "huge flag-ship" "Minotaur," and her sister ship "Northumberland," showed marked superiority to the smaller and more recently constructed ironclads, one of which, the twin-screw warship "Penelope," fell off to leeward of the larger ships by no less than two miles in one forenoon. The gale increased in strength until its force was logged at eleven, or one less than the maximum of twelve, the force of a hurricane. All the ships were soon under close-reefed fore and main topsails except the "Penelope," which, on account of her leewardly tendencies, had to keep under easy steam with fore and aft sails set. The heavy sea and the bad weather tested the sea-going qualities of the ironclads thoroughly. All behaved admirably, especially the larger vessels, although they rolled considerably. The "Minotaur" and "Northumberland" rolled 12 deg. and 14 deg. each way. The "Bellerophon" reached 25 deg., and the "Defence" 30 deg. The "Penelope," having so little sail set, was in this respect by far the worst, and rolled to 35 deg. On one occasion a heavy roll caused her to dip the end of her bridge under water, while another admitted a sea over the lee waist. The gale lasted several days, but with the exception of the "Penelope," all the vessels were reported to have come through it "as dry as a bone." Not a single rope yarn was stranded or the smallest injury sustained during the entire passage to Lisbon. The general impression derived from the experience of the voyage was that in similar circumstances the old class of wooden line-of-battle ships would have made "infinitely worse weather of it in every way," and that henceforth there could be no doubt that our broadside ironclads were capable of facing the heaviest gale with impunity.

Electrical Engineering in 1928.

No. II. (*conclusion*).*

Research.

So wide is the field covered by the eighth Annual Report of the British Electrical and Allied Industries Research Association for the period from October 1st, 1927, to September, 1928, that anything beyond a brief reference to a few of the Association's activities is out of the question. A comprehensive research into the problems arising in the construction and use of overhead electric lines was described by Mr. W. B. Woodhouse in a recent paper read before the Institution of Electrical Engineers. Wooden poles that represented standard practice when the research was begun have been superseded as the results of the discoveries made, and it is said that the research has conferred considerable benefit on the electrical industry. A report was also presented to the Institution on researches on the effects of impurities in insulating oils carried out for the Association by the Metropolitan-Vickers Electrical Company. Another report presented to the same body deals with researches conducted at Newcastle into the phenomena of circuit breaking, researches which have resulted in further discoveries and inventions of no small importance. Reports were received by the Association from the National Physical Laboratory on the application of Schweidler's laws to certain dielectrics under conditions of humidity, temperature and electric stress approximating to normal and abnormal conditions, and a considerable amount of additional research work of this nature is contemplated. The second volume on dielectric phenomena by Mr. S. Whitehead, dealing with discharges in liquids, was published, whilst a third volume, dealing with solid insulators, is being prepared for the Press. A comprehensive research carried out for the Association by the Metropolitan-Vickers Electrical Company demonstrates the nature and magnitude of contact resistance phenomena between metals and dielectrics, a research which has an important bearing on volume resistivity and dielectric loss measurements. New observations made on the heating of buried cables are expected to prove of equal value to those which were made previously. For the benefit of cable makers an important investigation was undertaken on the problems of differential expansion and other properties of electric cables, another investigation that is expected to prove of considerable value to the electrical industry when it is completed. Finally, reports have been supplied to the British Standards Association that should prove of assistance in the preparation of standard specifications.

In the Wembley research laboratories of the General Electric Company important work was carried out on street lighting. As the result of the development of a one-piece asymmetric street lighting reflector an efficient method was devised of utilising the light from street lamps when the posts are far apart and when the road is narrow or of medium width. Previous devices for the same purpose employ two separate reflectors, but by means of internal vertical and external horizontal prisms and an elliptical shape it has been possible to design a one-piece reflector. With the investigatory work for the Committee that framed the B.E.S.A. standard specification for street lighting the staff of the Wembley laboratories was closely connected, and the specification which classifies street lighting installations according to the minimum horizontal illumination in the street and specifies, among other things, the minimum heights of fittings, is said to be proving of great value to those associated with street lighting work. In the field of photometric measurement there was progress in the development of a photo-electric photometer, which, like the lamp rating machine, developed in these laboratories, enables precise photometric measurements to be made without the aid of the human eye and its attendant inconsistencies. An all-round advance was made in gas-filled lamps for the efficiency and candle-power maintenance during life were improved.

The Metropolitan-Vickers Electrical Company's research department continues to maintain the necessary supply of information to the engineering and manufacturing departments. Induction furnaces with an output of several tons of steel per day develeoped in the laboratories are now in commercial operation. In connection with an investigation into the properties of fluid insulators with a view to their improvement a still was developed which represents a considerable advance on previous practice. One of the first products of this still was a low vapour pressuregrease which has attracted world-wide interest in the domain of science. Among other properties this grease possesses is the quality of being non-vaporisable in the highest vacuum, a property which makes it of great value in work requiring low gas vapour pressures. The use of high-speed electrons and their effect is being studied, whilst the use of X-rays as a means for the more fundamental study of materials is being extended with success. The department's facilities for the working of rare metals has been extended by the installation of a swaging and wire drawing plant, and the experience gained in the production and working of these metals has resulted in the production of metal electrodes which are now used as standards for spectroscopic analysis. To ensure the employment of materials that under high temperature and pressure will give the required life service without significant creep a special testing outfit was evolved. By means of this apparatus independent tests can be made simultaneously with as many as six specimens of material in any desired combination of stress, temperature, and surrounding media. The loading is done by dead weights with a leverage ratio of 10 to 1, whilst uniform electrical heating is provided for any temperature up to 900 deg. Cent. Control gear is provided that automatically maintains temperature uniform within plus or minus half a degree Centigrade throughout periods extending to several months, and an extensometer has been devised which measures a creep of one-millionth of an inch of specimen. In a separate equipment tests for creep on specimens of steel are made continuously in a superheated steam atmosphere at temperatures up to 550 deg. Cent. or 1000 deg. Fah.

* No. I. appeared January 4th.

Wireless Communication.

About the end of 1925, the Post Office decided to investigate the possibilities of radio-telephony on short-wave lengths, and in 1926 begun experimental work in some converted farm buildings, some little distance from the Rugby Radio Station. Early work demonstrated the necessity for rigid frequency control of the transmitter, which was obtained by utilising the quartz crystal drive system. Oscillations of a high degree of constancy are generated at a wave length in the neighbourhood of 120 m., and are subsequently magnified in strength and multiplied in frequency in the remaining stages of the transmitter. The total input to the transmitter is about 20 kilowatts, and the output is delivered at wave lengths of 16 m., 24 m., or 33 m., the transmitting apparatus being connected to aerials for one or other of these wave lengths by means of transmission lines. The direction aerials are designed to produce sharply defined radiation in the direction of New York. In June of 1928 the set was put into use as an auxiliary channel for Transatlantic telephony, and it provides a second channel during a portion of the working period, and also fills the occasional periods when, owing to abnormal atmospheric conditions, the long wave circuit becomes uncommercial. At the same time, the American Telephone and Telegraph Company put a corresponding set into operation at Deal Beach, New Jersey. Reception from America is obtained in this country on a short-wave receiver at the existing receiving station at Cupar Fife, as well as at an experimental receiving station at the works of Standard Telephones and Cables, Ltd., New Southgate. Directive antennæ are being used for reception at both these stations. In due course, the work carried out in both the stations will be transferred to a new centralised and comprehensive short-wave receiving station. The short-wave channel is terminated at the Trunk Exchange, London, adjacent to the long-wave channel, and it is possible, if desired, to combine a long-wave route in one direction with a short-wave route in the other. Experience has shown that by the association of a long-wave channel with a supplementary short-wave channel, an efficient commercial wireless telephone service can be maintained between such towns as London, Stockholm, Prague, Madrid on one side, and New York, San Francisco, Vancouver, Mexico City on the other, with an extremely small percentage of lost circuit time. Many calls have been successful on a circuit of over 8000 miles between subscribers. Improvements have been effected in the method of reception on long waves at Cupar by the development of six spaced frame vertical combinations as an alternative to the wave antenna system originally installed.

The transmitting station serving the long-distance ship-to-shore traffic was originally situated at Devizes where there were two long-wave 6 kilowatt sets, one of which had been in operation from the time of the inception of the station. There was also a short-wave set. In consequence of the expansion of traffic, arrangements were made in 1927 for the building of a new station at Portishead, conveniently situated in the Bristol Channel, about 25 miles from the complimentary receiving station at Burhnam-on-Sea, and this station is equipped with two 6-kilowatt transmitters and one 25-kilowatt transmitter. All these transmitters are excited from tuning fork units, four of which have been installed. Each tuning fork is capable of being used on two frequencies, and can readily be used to excite any transmitter. The new aerial system consists of four steel lattice masts, arranged in the form of a Y, and supporting the three aerials at a height of 300ft. A short-wave transmitter working on 16·8 m. and 36·5 m., was installed at Portishead for the ship and shore service.

During 1928 very many new commercial, ship and broadcast stations were brought into use, resulting in a general overcrowding of the ether. The difficulties of reception free from interference have increased, particularly in the broadcast band of wave lengths, and while this is a development that is not welcomed, it has provided a stimulus on the one hand to the production of transmitters having a stability, constancy of wave length, and accuracy of adjustment hitherto unnecessary, and on the other to the construction of receivers possessing selectivity far in advance of that of previous models. The beam system relies largely on the constancy of wave length of its transmitter for its success, and further development of the independent drive system which is used on all beam transmitters was made during the year. Although crystal control of wave length is being employed to an increasing extent, the relative inflexibility of a transmitter controlled in this way is in some cases a disadvantage, whilst there is a risk that the internal strains in the crystal may find relief by changing its natural period of vibration. A constant-frequency tuning fork, involving more elaborate equipment, is more reliable than an oscillatory crystal. It can be adjusted to a finer degree of frequency, and, as in the case of the crystal, it can be maintained at that frequency by thermostatic control.

The screened grid valve, which was introduced in 1927, contributed largely to receiver design in 1928. By its use very great high-frequency magnification is produced without detriment to stability. The experimental high-power short-wave broadcasting station 5SW, with its world-wide range, has now completed more than a year's service, and has demonstrated the possibilities of Imperial broadcasting, while the relaying of the Schenectady transmission from 2LO by means of special aerial reception at Tarling, near Witham, on the occasion of the landing of the airship "Count Zeppelin" at New York, has demonstrated the progress which has been made in reducing fading on Transatlantic broadcasts. Considerable development took place in the design of drive controlled low-power transmitters for aircraft use, &c., both for long and short-wave working. In connection with aircraft work, remarkable results were obtained with waves in the neighbourhood of 40 m., and although it is at present too early to state definitely to what extent short waves will be used in aircraft communication interesting possibilities are in sight. With the beam system of telegraphy and telephony, the use of the multiplex system of signalling promises great advantages. The diversion of one carrier into several distinct channels by heterogeneous modulation should do much to increase the amount of traffic that can be handled by any one particular beam, whilst the ingenious method for overcoming fading should also prove of the greatest value. Although research work has been carried out on facsimile work, and picture telegraphy for several years, the facsimile transmission of messages and pictures over land lines has only recently been made a commercial success. Certain kinds of material can now be satisfactorily transmitted by wireless, but it is more difficult to obtain true facsimile reproduction, involving a high degree of accuracy, by wireless than by land line, owing to certain distortion effects which take place in the medium between the two stations, arising from reflection from the Heaviside layer. The research engineers of the Marconi Company are now concentrating their efforts on overcoming this difficulty, and an experimental service between England and America has for some time been giving good results. Together with the advent of regular transmissions of pictures by the B.B.C., this fact clearly foreshadows an extension of this development within a reasonable time.

Much might be written on marine wireless development, but it must suffice to say that the Radio-Telegraphic Conference at Washington has brought about the introduction of valve transmitters for ship purposes in all cases in which the installation is more powerful than that generally referred to as "quarter kilowatt," and after the end of 1929 valve transmitters will be fitted in all new ships which carry any but the smallest type of installation. The main object of the change is to reduce the interference caused to other services, chiefly broadcasting, by installations fitted to ships and those that are provided on land for the purpose of communicating with ships.

Hydro-electric Work.

The Maentwrog hydro-electric generating station of the North Wales Power Company, Ltd., was formally opened and put into service on October 15th, 1928, by Mrs. Wilfrid Ashley, the wife of the Minister of Transport. The ceremony marked the completion of another stage in the extensive scheme of development by means of which the whole of North Wales has now or will very shortly have the benefit of obtaining supplies of electrical energy. The generating plant for the initial development of the new station is composed of three Boving turbines, each coupled to a 7500-kVA, 6600-volt, 50-cycle, three-phase alternator built by the English Electric Company, Ltd. Following the starting up of the first reconstructed impulse water turbine at the Kinlochleven works of the British Aluminium Company, an order was received by the English Electric Company for the reconstruction of eight other old Escher-Wyss turbines at this station. The efficiency of the first turbine was raised as a result of the reconstruction from 73 per cent. to 89½ per cent., equivalent to an increased output of no less than 22 per cent. The North British Aluminium Company's new hydro-electric project at Lochaber is steadily progressing. The five 9000 horse-power impulse water turbines and ten 3000-kW direct-current generators are in an advanced stage of manufacture at the English Electric Company's Rugby and Stafford works, and it is expected that some of this plant will be delivered early in the coming year. For the Public Works

Department, New Zealand, an order for a 12,650 horse-power water turbine and 7500-kW alternator was received.

Automatic equipment which the B.T.H. Company is constructing for the new No. 1 Waipori station of the Dunedin City Council, New Zealand, is of considerable interest. The alternator controlled by this gear is to be a 3750-kVA machine at ·8 power factor and it will be driven by a Boving water wheel. The automatic gear will be arranged so that upon the operation of a control switch on the switchboard the turbine gates will open and start up the turbo-alternator, which will synchronise itself and couple itself to the 32,000-volt transmission line. The set will shut down entirely automatically after the operation of the control switch on the switchboard, and when it is working on the line it will be possible to control the load either by a control switch on the switchboard operating the governor motor or automatically by a float control gear which will set the gate opening of the turbines and hence the load on the generator, so that the turbine passes an amount of water sufficient to maintain a constant head of water in the weir above No. 2 station, which is lower down the stream than the No. 1 station. Means will be provided for changing over from the control switch to the float control and *vice versâ* without disconnecting the alternator from the line. It will also be possible to control the station manually. The equipment will be designed so that at a later date it will be possible to install supervisory control gear and control the alternator from No. 2 station, 2½ miles away.

Among the Metrovick water wheel alternators installed were three 13,330-kVA vertical machines for the Compania Hirdro-Electria Volcan, of Chili, and two 20,000-kVA machines forming the initial equipment of the new Waikaremoana generating station of the North Island of New Zealand. A considerable number of salient-pole machines were built by this firm for coupling to water wheels and engines. Additional installations of completely automatic synchronising gear for hydro-electric power stations were put into operation by this firm.

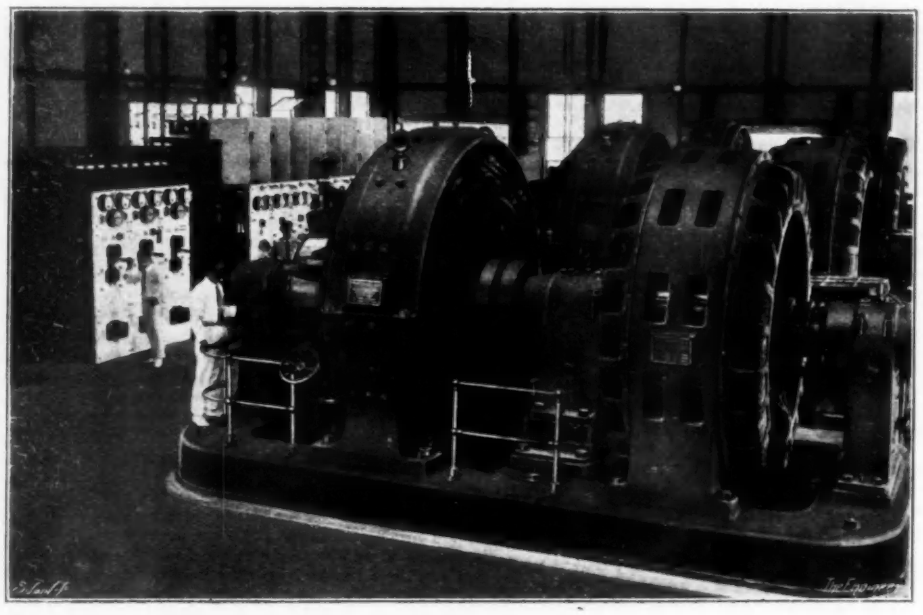


FIG. 5—1500-VOLT MOTOR CONVERTERS

Electric Traction.

For the supply of 1500-volt direct current to electric railways rotary converters are often utilised, but there is some diversity of opinion as to whether they are satisfactory when they are supplied with 50-cycle current. Two 750-volt rotary converters are therefore occasionally connected in series, but within recent times there has been a tendency to make use of motor converters which run at half the synchronous speed corresponding to the supply. During the period under review some fairly large machines of this type—see Fig. 5—were made by Bruce Peebles and Co., Ltd., of Edinburgh, who at one time were the sole makers of motor converters in this country. Eight of these machines have been built for a 1500-volt main line scheme, each rated at 2000 kW and giving 1500 volts on a single commutator when supplied with 50-cycle current. The sub-stations in which the converters are installed are fed at 66,000 volts and transformers reduce the pressure to 6600 volts, which is the pressure applied to the stator windings. For a period of two hours the machines will carry overloads of 50 per cent., and 100 per cent. overloads for five minutes. They have, of course, also been designed to stand up to short-circuit conditions. By means of a three-phase starter in the rotor circuit starting and synchronising are carried out in the ordinary way, but on account of the comparatively high slip ring voltage the starting and synchronising switch is of the totally enclosed oil-immersed ironclad type. It is said that owing to the design of the direct-current brush gear and commutator and the provision of flash guards the machines are immune from flash-over between brush spindles, whilst the high centre line of the rotating element and the provision of insulating shields over the pedestal at the commutator end ensure that no arc can be formed to earth. All the large electrical firms carried out a fair amount of electric traction work, most of which conforms with orthodox practice. For the Great Indian Peninsula Railway the General Electric Company, along with Hawthorn, Leslie and Co., Ltd., built a 2250 horse-power electric locomotive which was shipped to Bombay during the year. Two Diesel-electric locomotives are also being built by this firm and William Beardmore and Co., for the North-Western Railway of India, and a large number of motors for the London Underground Railways. A contract placed with the Metropolitan-Vickers Electrical Company for forty-one 2600 horse-power goods locomotives for the Great Indian Peninsula Railway is rapidly approaching completion. The mechanical parts are built to the designs of the Swiss Locomotive and Machine Works, of Winterthur, who supplied parts for ten locomotives. The mechanical parts of the other locomotives are being constructed by the Vulcan Foundry Company, Ltd., to Winterthur designs. A 3600 horse-power express passenger engine is being constructed jointly by the Metropolitan-Vickers Electrical Company and the Sociedad Espanola de Construccion Naval for main line service on the Norte Railway of Spain. For multiple-unit trains and for electric tramcars the Metropolitan-Vickers Electrical Company is constructing many electric equipments. The British Thomson-Houston Company was engaged upon the manufacture of 524 control equipments for motor and trailer cars for the London Electric Railway, and Metropolitan District Railway. From a technical point of view the electrification of the Swansea and Mumbles Railway, for which the British Thomson-Houston Company manufactured the complete electrical equipment for the coaches, is of considerable interest, but the details of this work cannot be described here.

Switchgear.

The Government's 132-kV grid scheme has naturally led switchgear manufacturers to turn their attention to the design of switchgear suitable for this high pressure, and with high-rupturing capacity. For the Central Scotland section of the scheme the British Thomson-Houston Company and the Metropolitan Vickers Electrical Company are both engaged upon the construction of 132-kV switches. Switchgear for seven stations in the Glasgow area is being manufactured by the latter firm. A special feature of these stations is the adoption of reinforced concrete pillar supports for isolators and connection insulator posts, in order to reduce the amount and cost of steel work, and to produce a neat form of sub-station. Each of the "grid" triple-pole oil-immersed circuit breakers—see Fig. 6—under construction at the switchgear works of the B.T.H. Company has a rupturing capacity of 1,500,000 kVA, and is operated by an electrically controlled solenoid mechanism. A separate oil tank constructed on the lines of a Lancashire boiler is provided for each phase, and access to the interior is obtained through a manhole in the top cover. For the larger power stations there was an interesting development of heavy metal-clad B.T.H. oil-filled switchgear of the double bus-bar type, with duplicate circuit breakers, with a rupturing capacity of 1,500,000 kVA for 11,000, 22,000 and 33,000 volts. This gear is suitable for indoor or outdoor service, and the parts are located so that each set of bus-bars is physically separate from its associated oil circuit breaker, thus ensuring maximum safety under fault conditions. The parts are composed of fabricated material, the supporting framework and enclosure being made of heavy rolled sections which can readily be repainted in service. Another interesting B.T.H. development was the design of metal-clad vertical plugging switchgear, suitable for service under the most adverse climatic and general conditions. Here, again, the fabricated form of construction has been adopted, and for extra high-voltage work oil filling is employed instead of the usual compound filling. The development is on similar lines to those of the power station auxiliary switchgear supplied to the Sydney Municipal Council for the Bunnerong power station.

Details of many important B.T.H. switchgear contracts have been sent to us, as well as particulars of other technical developments. As regards general development in the switchgear department of the Metropolitan-Vickers Electrical Company, perhaps the most notable features were the addition of oil-immersed selector switches to duplicate bus-bar metal-clad units, in order to facilitate change-over from one bus-bar to the other, and the introduction of welded and fabricated steel parts to replace castings and so to reduce weight without detriment to strength. Many important orders were secured by this firm, some of which were the direct result of the "grid" scheme, existing switchgear having to be extended or remodelled to allow for the selected stations to be connected to the grid. Besides these contracts, however, the company is carrying out a good deal of high-voltage switchgear work for abroad, including extensions to the original 132-kV contract for the Victoria Falls and Transvaal Power

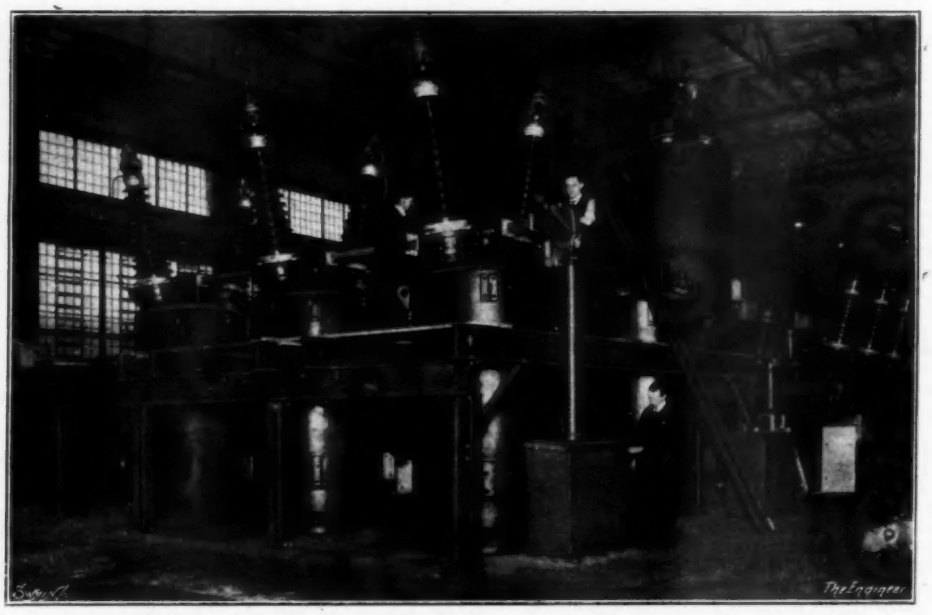


FIG. 6—"GRID" TRIPLE-POLE OIL-IMMERSED CIRCUIT-BREAKERS

Company. The General Electric Company's metal-clad switchgear installed in the Aldwych automatic sub-station, referred to in our issue of December 7th, presents interesting features, bus-bar selection being obtained by an ingenious plug contact assembly known as a "revolving turret," with which the entire process of changing from one set of bus-bars to another only occupies a few minutes. Switchgear is being constructed in the Witton works for the Palestine electrification scheme and for New Zealand and Australia. A. Reyrolle and Co., Ltd., report that there was increased demand for metal-clad switchgear, and that the "grid" is affording new opportunities for the use in this country of high-voltage gear, which has been manufactured in this country in the past, but mainly for use overseas.

Transformers.

Tap-changing gear for altering the voltage of transformers whilst they are under load is claiming the attention of most transformer manufacturers, and Ferranti, Ltd., which put gear of this kind on the market during 1927 made further progress in its construction during the year under review. For the national power scheme, this firm is building the largest three-phase transformers so far made in this country, namely, 30,000-kVA, 132,000-volt transformers, which are to be provided with tap-changing gear that operates under load. The firm also constructed some high-voltage testing and experimental equipments. For general and scientific experimental work a million volt equipment was supplied to the National Physical Laboratory, and a permanent million-volt testing laboratory was set up in the company's Hollinwood works. In both cases the cascade connection is employed, but one of the equipments is air-insulated, whilst the other is oil insulated. Transformers with tap-changing on load equipment are being made by the B.T.H. Company for the Irish Free State Electricity Supply Board. The contract covers three 12,000-kVA, 110,000/38,000-volt 3-phase transformers, which will

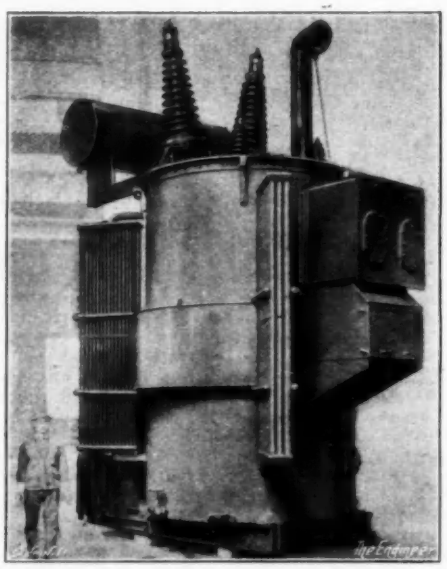


FIG 7—TRANSFORMER WITH TAP CHANGING GEAR

be installed in the main transformer station, which will operate in parallel with an existing power station and supply a large part of the city. The transformers will have air jet cooling equipment, but it will be possible to operate them at loads up to 7500 kVA, as self-cooled units. The air jet cooling apparatus will only be brought into operation on the heavier loads. To compensate for the voltage regulation of the 110,000-volt transmission line and the 38,000-volt cable system, the 38,000-volt winding will be provided with tap-changing equipment. A typical B.T.H. transformer with tap-changing equipment is shown in Fig. 7. A single unit core type, oil-immersed, self-cooled, testing transformer, capable of giving over half a million volts and suitable for connecting at a later date to give three-quarters of a million volts, was manufactured in the Rugby works. A similar transformer, designed for a pressure of one million volts, was also manufactured for use in the Willesden works. Many transformers, including two 25,000-kVA, three-phase, 6600/33,000-volt, core-type, forced-cooled units, for the Manchester Corporation, were made by the Metropolitan-Vickers Electrical Company. For the Central Scotland scheme, the firm is building six 20,000-kVA single-phase transformers for two 60,000-kVA three-phase banks, nine 15,000-kVA single-phase units for three 45,000-kVA three-phase banks, and two 15,000 three-phase transformers. All these transformers will operate on the 132,000-volt lines, and both the single-phase and three-phase units will be of the shell type. Tap changing on load will be one of the features of these "grid" transformers, which will work with natural and artificial cooling. The tappings will be brought out from the neutral end of the 132,000-volt winding, so that all the tap-changing gear will be at a relatively low potential above earth. A large amount of interesting transformer work was also carried out by Bruce Peebles and Co., Ltd., of Edinburgh.

Automatic Control Gear.

An interesting application of automatic control is met with in a power factor correcting scheme devised by the General Electric Company. It was desired at an ironworks where the tariff is based on the maximum kVA demand that the power factor of the load should be maintained at unity during those periods of the day when the kVA load approached the maximum demand. For correcting the power factor a synchronous condenser has been installed, but it is obviously unnecessary to correct the power factor during those parts of the day when the kVA load is below the maximum demand; in fact, this practice would incur unnecessary expense owing to the light running loss of the condenser. Automatic relays and other necessary gear have therefore been brought into use so that the condenser will start up and stop as required, and at all loads an automatic field regulator adjusts the excitation of the condenser so that it maintains unity power factor on the incoming supply. The synchronous condenser is a 400-kVA machine running at 1000 revolutions per minute on a 3300-volt 50-cycle current. The use of automatic control gear in this country appears to be increasing rapidly, especially in sub-stations. The official opening of the new Aldwych automatic sub-station for which the General Electric Company was responsible was recorded in our columns only a few weeks ago, whilst in our issue of May 25th, 1928, we published a more or less detached description of the automatic sub-stations at Brighton, equipped by Bruce Peebles and Co., Ltd. From the British Thomson-Houston Company, the English Electric Company, and the Metropolitan-Vickers Electrical Company, we have received particulars of much work of this nature. Some interesting automatic control gear for hydro-electric stations is referred to under the heading of hydro-electric work.

Miscellaneous.

It would be possible to write many more columns on the work of the electrical manufacturers during the past twelve months, but we must bring this review to a close by referring to a few matters of general interest. One of the things that the Government's scheme of interconnecting power stations seems to have done is to create a demand for frequency changers. A 30,000-kilowatt reversible frequency changer was made for use in this country by the Metropolitan-Vickers Electrical Company, and a 5000-kilowatt set by the B.T.H. Company. The former machine will carry peak loads up to 100,000 kilowatts without falling out of step. Synchronous condensers also appear to be coming into use. Squirrel-cage motors with a high starting torque are rapidly acquiring popularity, over 100 of these motors, known as "textorque" motors and designed mainly for the textile industry, having been supplied to a new section of the Dunlop Rubber Company's cotton mill near Rochdale by the English Electric Company. The same firm has developed a compensated slip-ring induction motor, with a leading power factor, and a new air break starter for squirrel-cage machines. There was considerable progress in induction furnace work, and at the Stafford works of the English Electric Company nine alternators, having an aggregate capacity of 1895 kilowatts and generating single-phase current at frequencies of 500 to 2200 cycles, were built. For use in its own works this company has built a high-voltage testing plant, designed for very high frequency, which enables a searching test to be applied between the turns of a winding of a finished machine or transformer The Metropolitan-Vickers Electrical Company also reports good progress in induction furnace work, as well as in the construction of electric baking ovens, which are also being made in considerable numbers by the General Electric Company. Progress was made by Ferranti, Ltd., in the development of a new type of surge absorber, which does not involve connecting the line to earth, with consequent interruption of the supply, and for testing and experimental work on these absorbers a large "lightning generator" was constructed, by means of which high-voltage surges can be produced at will.

One of the outstanding contracts of the year was placed with the General Electric Company by the Central Electricity Board for one of the two sections of the overhead transmission lines in the South-East of England in connection with the scheme of electrical organisation throughout the country defined in the Electrical (Supply) Act, 1926. The contract, the value of which is approximately £500,000, will cover the erection of the 132,000-volt line in the district north of the Thames, stretching from Reading to the west of Peterborough on the north, and Ipswich and Colchester on the east. The total mileage of the overhead transmission will be something like 254 miles and the total length of the conductor will be approximately 1300 miles. The work of erection will be undertaken by the Pirelli-General Cable Works, Ltd., of Southampton, and will occupy in all three years, employment being given in this actual erection work to between 500 and 1000 men. In addition to this employment will be given to large numbers in the manufacture of the steel towers, steel-aluminium conductor, insulators, and other accessories.

Sanitary Engineering in 1928.

THERE is no outstanding discovery or development in connection with sewage disposal which can be chronicled as having been made or as having taken place during the year.

Mention should be made, however, of the experiments, which, we understand, are being made at Burton-on-Trent in connection with the use of ultra-violet rays to purify sewage. Ultra-violet rays have for a long time now been employed in France for the sterilisation of water supplies, the rays having a strong germicidal effect. There appears to be no reason why they should not be effective in killing the bacteria in sewage, but whether or not their use will be practicable will depend on what it costs to employ them. At present, we gather, the experiments at Burton-on-Trent, though successful, have only been on a small scale.

The growth in the use of the activated sludge method of treatment, in one or other of its forms, has continued, but there is nothing new in connection with it to put on record. Many places, however, appear to be experiencing trouble from odours from sludge, especially from activated sludge when drying. The odour is due to the formation of sulphuretted hydrogen, which is a heavy gas that has a tendency to cling to the ground. Remedial measures in the form of the addition of chlorine, either in the liquid state or in combination with lime, seem to have been efficacious in several places, both in this country and in the United States.

Though no novelty can be pointed to, there is a very large amount of sanitary engineering work of various kinds being carried on throughout the length and breadth of the country. Omitting places, the estimated cost of the works at which does not amount to £25,000—and there is a vast number with schemes in hand which will cost anything from a few hundreds up to very nearly that figure—the following places have in hand, have completed during the year, or have in contemplation sewerage or sewage disposal works—or both:—Ardwick-le-Street; Atcham, for the Halecott Estate; Aylesham; Bangor (County Down); Barton-on-Irwell; Bath; Bexhill; Birmingham; Blackburn; Braintree; Broadstairs; Burnley; Caterham; Chatham; Cheam; Clacton; Clowne; Cobham; Coseley; Coventry; Croydon; Derby; Dewsbury; Droitwich; Eastry; Edinburgh; Esher and the Dittons; Exeter; Falmouth; Gelligaer (Glamorgan); Gravesend; Heysham; Hinckley; Hutton and Wickford (Essex); Ilford and Barking; Ipswich; Leatherhead and Ashtead; Leeds; Luton; Lytham and St. Annes; Maidstone; Monkton Combe and Avon Valley; Newcastle-under-Lyme; Newton Abbot; Northampton; Nottingham; Nuneaton; Petersfield; Poole; Portadown; Rhyl; Richmond (Surrey); Rochester; Romford; Rothwell (Yorks.); Sedgley (Staffs.); Shanklin; Sheffield; Smallborough; Southend; South Mimms; Southport; Stoke-on-Trent; Swansea; Swindon; Swinton (Yorks.); Tettenhall; Twickenham; Uxbridge; the Wandle Valley; Watford; Whickham; Whitby; Wirral; Wolstanton; Wolverhampton; and Woodford. To some of these we refer in greater detail below.

The Ipswich Town Council has approved the construction of a high-level intercepting sewer and new disposal works at an estimated cost of £190,000. The matter is now in the hands of the Ministry of Health and is awaiting a local inquiry. The new works which the Uxbridge Rural District Council has constructed for the drainage of Ickenham, Hillingdon and Harefield were put into operation in the middle of December. The sewering of these districts is still in progress. The estimated cost of the whole of this undertaking is £130,000 and the value of the work completed to date is about £80,000. The reorganisation of the Whitby sewerage was completed during the autumn. It included the construction of intercepting sewers, a harbour crossing, a low-level pumping station and a sea outfall. The cost of this undertaking, of which we hope to give a description in a future issue, was about £53,000. A proposal to combine the sewage works of Newcastle-under-Lyme, Wolstanton, and Stoke-on-Trent has been formulated, but no decision has as yet been arrived at concerning it.

London Main Drainage.

In connection with London Main Drainage the following works were in hand:—

Lewisham Branch Sewer: Branch from Hither Green.—This sewer, which is 5ft. internal diameter and 3000ft. long and is constructed of iron segments lined with concrete and partly carried out in compressed air, was completed and brought into use during the year.

Extension of Streatham and Balham Storm Relief Sewer.—This brick sewer—5ft. by 3ft. 6in., egg-shaped—constructed in tunnel, length about 1200ft., was also completed last year.

Crossness Outfall Works: Overhead Sludge Tanks.—Two cast iron sludge tanks, each with a capacity of 1600 tons, were erected during the year over the existing sludge settling channels. These tanks are 100ft. by 60ft. and 10ft. deep, and rest on steel girders with concrete piers. The top sludge level is at + 49·50, or about 35ft. above the natural ground level. Sludge will be pumped into these tanks from the sludge settling channels, and discharged by gravitation into the sludge vessels, each of 1500 tons capacity, for removal to sea. At these works also a large mansard type roof over the main engine-house, which required extensive repair, was removed and a new concrete roof of 46ft. 6in. span and 146ft. in length, supported by hog-backed lattice girders, was constructed to replace it. In order to avoid any interference with the running of the pumping machinery, the new roof was constructed under the old one, which was afterwards removed.

Birmingham.

A good deal of preliminary work was done during the year with the various important sewerage schemes, which are being carried out by Birmingham or in contemplation, and which were mentioned in our last year's Annual Article. Taking them in the order given in that article, the following progress was made:—

River Rea Improvement.—The scheme for the improvement of the River Rea, draining an area of approximately 34 square miles in the City, was submitted to and approved by the City Council. It involves the deepening and widening of practically the whole length of the river channel, which is, at present, part brick and concrete, and part earthwork, the reconstruction of bridges, &c., and of main and branch sewers. A Bill is being promoted in Parliament during this session, the whole of the parliamentary plans having been prepared. The magnitude of this work of preparation may be judged by the fact that the book of parliamentary plans to a scale of 1/500 and 1/2500, together with bridge sections, &c., of which there are sixty-nine to be dealt with, contains fifty-three sheets.

Perry Bar Sewerage.—A large portion of the scheme for the main sewerage of portions of Perry Bar was sanctioned by the Ministry of Health, and was actually in course of construction.

North Handsworth Sewerage.—The report on the scheme for the drainage of North Handsworth was circulated to the Authorities concerned, which held a joint meeting to discuss the matter and are now individually considering the report and its alternatives.

The extent of these various schemes may be judged by the fact that the combined expenditure would probably amount to between three and four million pounds sterling.

Blackpool.

The main sewerage scheme, which was referred to in our last Annual Article, made considerable progress during the year. About 1700 yards of the Devonshire-square to Marton Mere Storm overflow were laid by the end of the year, and work is now in progress to complete that section. The new main sewer from Rigby-road to Rectory-road is also now in progress. It is being constructed in its lower lengths as a rectangular reinforced concrete culvert with a dished invert. Pre-cast reinforced invert blocks are laid in the trench bottom, and the sides and roof are then cast *in situ*. Metal moulds are being used for the interior of the culvert, the outside being moulded on to wooden forms. Peaty ground on this length necessitated piling at certain points, and advantage was taken of the box form of the culvert to pile in groups and reinforce the culvert longitudinally to span between the pile groups in the case of subsidence under the culvert.

Contracts for new pumping plant for Manchester-square, Rigby-road, and Bloomfield-road Pumping Stations were let, and the work of installation of new plant is now in progress. The pumps to be installed are of the axial flow type and they will replace old steam and gas-driven centrifugal pumps, the capacity of which is now too low for the duty required.

Bournemouth.

The principal work carried out during the year was (*a*) the lengthening of two sea outfalls to a length of 2000ft. below O.T. line into 30ft. of water, and (*b*) the construction of the Northern Drainage system. The latter is to provide for the drainage of the remaining undeveloped area of the borough. It consists of a pipe line, 6 miles long, contouring round the Northern boundary and leading to a small pumping station where the sewage will be lifted 17ft. by Stereophagus pumps into a short length of sewer connection the sea outfall, and will, after being lifted, be discharged by gravitation at all states of the tide. Surface drains over the route have also been provided. The cost of the scheme is approximately £120,000.

Bradford.

The Esholt sewage disposal scheme provides for a total of 60 acres of bacterial filters and the area now in use is 25½ acres. During the past year 4½ acres of water-wheel driven rectangular travelling distributors were installed. A further 11 acres of filters were constructed, and 6 acres of them have been filled with filtering media. The excavation for a 4½-acre bed was completed. The main supply pipes to the filters were extended, and a length of branch effluent conduit constructed.

Brighton.

The work of constructing the new sea outfall, which was referred to in our last Annual Article, continued throughout the year, and it will take another twelve months to complete it. The outfall, which comprises two lines of 5ft. diameter cast iron pipes, is being laid by John Gill (Contractors), Ltd., and a contract is shortly to be entered into for the installation of pumps for dealing with three times the dry-weather flow during the high-water periods. Various schemes are being prepared for the recently extended areas of the Borough, including Rottingdean, Ovingdean, and Patcham. Most of this work will be on the partially separate system in view of the fact that pumping has to be resorted to at the outfall. Steps are also to be taken to separate some of the water drainage from the combined sewers in the old Borough, and all reconstruction schemes are being prepared with that object in view. For surface water drainage spun concrete tubes are used in all sizes above 15in.

Burnley.

Burnley has in preparation some extensive works in connection with the reconstruction of its main outfall sewer, and the remodelling of its disposal works at Duckpits and Wood End. With regard to the main outfall sewer, it is intended to construct a length of about 2000 yards of entirely new sewer adjacent to the existing 3ft. by 2ft. brick sewer, which is inadequate in capacity and in a structurally bad condition. The new sewer will be circular in shape, 1600 yards of it being 54in. diameter, laid with a gradient of 1 in 700, the remainder being 36in. diameter, with a gradient of 1 in 300. As the land through which it will pass is subject to mining subsidence, it will consist of cast iron or steel pipes. The proposed new works at Duckpits will largely consist of alterations to existing tanks and provision for the treatment of storm water. New screening and detritus tanks, with their necessary accessories, and a new pumping plant, are to be installed. The Wood End works to which it is proposed to pump the sludge for digestion and drying on ash beds, at present consist solely of double contact filter beds. It is intended to replace these beds by some more modern method of treatment. The process will probably be adopted.

Chatham and Rochester.

An important joint scheme embracing both Chatham and Rochester, has been in progress for some time, and is now nearing completion. As regards the Rochester portion, the City is first of all divided into two by the river Medway, and is further subdivided into High and Low Level areas. On the north side of the river the High Level area drains by gravity to the head of a syphon, which passes near a pumping station into the Low Level area, and from that point becomes a combined syphon and pumping main, which is carried across Rochester-road Bridge to the other side of the river. The sewage is pumped through it into a main concrete sewer, which is jointly owned by Rochester and Chatham. The pumping station which was put into service in October, is at Strood Fairground. The area to the south of the river is dealt with in a similar manner, there being a further pumping station for the purpose. Chatham sewage is also treated in a similar way. The work in connection with the internal drainage of that town, which has cost some £227,000 to carry out, and is now nearly finished, comprises some 50 miles of sewers and storm water drains, together with a low level pumping station. The work executed by the Joint Sewage Board, which was completed last month, consisted in the laying of a main joint outfall sewer, which runs from Rochester through Chatham to disposal works at Rainham, nearly 5 miles away, and the construction of the disposal works themselves. This portion of the works cost approximately a quarter of a million sterling.

Doncaster.

During the year the laying of the surface water drains in Town Moor-avenue from Sandringham-road to Thorne-road—Contract No. 9B, £4026—was completed, as also was that of the main intercepting sewer from Hyde Park to the Low Pasture—Contract No. 10, £9006—and the 21in. and 24in. cast iron rising main and gravitation main from the Low Pasture and The Holmes to Sandall Purification Works—Contract No. 11, £23,500. The works now being carried out are (*a*) the laying of the main intercepting sewer to the Low Pasture outfall works and the construction of detritus tanks, pumping station, storm water tanks, &c.—Contract No. 9, £126,000—(*b*) the installation of pumping machinery, switchgear, &c., at the Low Pasture Pumping Station—Contract No. 12, £4000—and (*c*) extensions to the Sandall Purification Works, comprising settling tanks, filter beds, humus tanks, sludge lagoons, effluent outfall culvert, &c.—Contract No. 13, £56,500. In the case of Contracts Nos. 9 and 12, it is anticipated that these Works will be put into operation at the end of this month.

At the present time, an application is before the Ministry of Health for a loan of £38,320 for Contract No. 14, which comprises extensions to the Balby Sewage Works.

Leeds.

During the year the following progress was made in connection with the Thorpe Stapleton sewage scheme of the Leeds Corporation:—At the Low Level Works the construction of the sewage precipitation tanks, the feed and effluent channels, the supernatant water culverts, and the sludge pumping station were so far advanced that these works are now nearing completion. The value of the contract is about £54,000. At the High Level Works the humus pumping station was completed. The total capital expenditure incurred during the year, including that on sewers, was £68,597, and the total expenditure on the whole scheme since it was entered upon in 1908 to September 30th last was £2,063,455.

Leicester.

In connection with the storm water and sewage disposal works which are being carried out by the City of Leicester, the extensions of the Abbey pumping station buildings were completed, and the three treble-ram pumps are in running order, each of them having been under load as required. The 44in. rising main was laid complete, and is in continuous use. The new bacterial works at Beaumont Leys Farm were also finished, and the thirty-two percolating filters are now in operation. The storm-water tanks at the Abbey pumping station are nearing completion, and good progress was made with the contract for the diversion of main sewers, screening plant, detritus tank, &c., and practically all underground works were completed. The contracts that have been entered into amount to well over £600,000, out of a total of £640,000.

Manchester.

In general, the method of treatment of sewage at the main outfall works, Davyhulme, and at the Withington works, Chorlton-cum-Hardy, remains as reported last year. An outstanding feature is the regular use of land at Flixton for the disposal of sludge from the Davyhulme works by "broadcasting" and for shallow trenching, which has afforded much-needed relief to the chief means of sludge disposal at the outfall works, Davyhulme, namely, that of sea disposal.

The portion of the new work connected with the preliminary treatment of the sewage at Davyhulme is nearing completion, the detritus tanks and screening chamber having been put into operation. The overflow and channel to convey storm water to the old screening and detritus chambers, which will, under the new scheme, be used only for the treatment of storm water, remain to be constructed. The new detritus tanks, of which there are six, are each 120ft. by 16ft. by 12ft. deep, and have a combined capacity equal to one-thirty-seventh of the dry-weather flow of 32 million gallons. A Priestman grab is used for the removal of the detritus and the top water can, if desired, be decanted. The screens used are of a new type made by Bracketts. They are composed of travelling wire ropes spaced ¼in. apart, the speed of which can be varied between 3¼ft. and 15ft. per minute. Four of these screens are at present in use, but provision has been made for the erection of two additional units in the future; channels having been made for their accommodation.

The preparation of the detailed drawings in connection with the installation of activated sludge plant to treat 18 million gallons dry-weather flow, together with storm water, is well advanced, and this portion of the extension scheme should be put in hand during the present year.

Main Drainage Work No. 13.—Work on the construction of the sewer which is to relieve the Irk Valley sewer was continued. It passes along Waterloo-road and Factory-lane, and is connected at the downstream end to the intercepting sewer, Work No. 5, in Rochdale-road. The internal diameter is 4ft. 6in., the length is about half a mile, and the depth varies from 17ft. to 143ft. On account of the nature of the ground, the sewer is of cast iron segments lined with brickwork and concrete, and is being constructed under compressed air.

Manchester and Salford Joint Storm Water Relief Sewer.—The 3ft. and 4ft. diameter storm relief sewer for the relief of storm waters from the Cheetham and Broughton Districts, was completed.

Whalley Range Drainage.—A sewer, which varies in size from 5ft. diameter to 3ft. diameter, for the relief of drainage in the Whalley Range district, is in course of construction.

Nottingham.

The Corporation of Nottingham intends to apply to Parliament for powers to enable it to carry out certain additions at its sewage disposal works, in order to deal with a largely increased volume of sewage. It is also intended to reconstruct the outfall

sewer, build a new pumping station with up-to-date equipment, and remodel to a very large extent the main sewerage system of the city. The approximate estimated cost is £1,000,000, and it is anticipated that the work will be spread over a considerable number of years, the intention of the Corporation being to put in hand only those parts of the work which are urgent at the moment.

Salford.

During the past year the River Committee purchased a new twin-screw sludge steamer, which is capable of carrying 1000 tons of wet sludge down the Ship Canal out to sea. It has a speed of 12 knots, and has proved to be of ample size to deal with the sludge output from the works. Work is at present in progress for the provision of sludge pumping arrangements from the storm-water tanks to the sludge tanks. The top water in the storm-water tanks is to be further drawn off by the provision of sectional decanting valves, after which the sludge remaining will be pumped by an electrically driven sludge pump through a 9in. pipe to the sludge tanks. Provision is being made at the same time for pumping humus sludge to a trade waste tank when required.

Sheffield.

During the year considerable progress was made with the scheme for the construction of eighteen units of plant for the treatment of sewage by the Bio-Aeration process. Each unit is capable of treating at least 1,000,000 gallons of sewage per day, together with the appropriate quantity of storm water. Fourteen of these units have already been put into operation and the remainder of the scheme will be completed during the next six months. The total estimated cost was £313,000, and it is now evident, we understand, that that sum will not be exceeded. The purification effected by the portion of the plant already in operation is quite satisfactory.

The Corporation has recently approved schemes for further extensions consisting of the construction of four additional units of the Bio-Aeration plant of similar size to those already completed, together with motor and pump houses adequate to accommodate further extensions, estimated to cost £84,000. A scheme for the construction of a large area of drying beds for the dewatering of sludge, estimated to cost £50,000, has also been approved. A Ministry of Health Inquiry respecting these schemes has been held, and sanction is awaited.

Southend.

Work on the new sewage works and sewage outfall, estimated to cost nearly £300,000, progressed rapidly during the year. Contracts for temporary works at Prittlewell, where the sewage purification works are situated, and for the sinking of five trial shafts, were completed and other contracts are now being executed. They include contracts for: 1½ miles of 60in. cast iron pipes, let to the Staveley Coal and Iron Company, Ltd., for £30,785; the laying of these pipes from the Eastern Esplanade at Thorpe Bay to below low water mark, let to Howard Farrow, Ltd., for £42,376; the laying of over 3 miles of a 9in. cast iron sludge main from Prittlewell to newly acquired sludge lands in the parish of Barling, together with the lay-out of those lands, let to Messrs. Crawford Brothers, for £11,363; the construction of 3½ miles of 60in. brick and concrete effluent conduit from Prittlewell to Thorpe Bay, chiefly in tunnel at depths varying from 20ft. to 70ft., let to G. Shellabear and Son, Ltd., for £107,951; the manufacture and installation of three 26 B.H.P. oil engine driven 8in. centrifugal pumping sets in the existing pumping station, let to Tangyes, Ltd., for £2148; and the manufacture and supply of 30in. cast iron manhole shafts and landing chambers for the manholes on the effluent conduit let to the Butterley Company, Ltd., for £2288.

About ¼ mile of sea outfall was completed, and six shafts of the effluent conduit tunnels are being worked night and day, the construction being so proportioned that miners and bricklayers each take twelve hours to complete their work in a 9ft. length. The strata encountered so far have been London clay.

Chicago.

A large sewage disposal plant was put into service by Chicago early in November. It is known as the North Side plant, and it is, we believe, the largest plant operating on the activated sludge principle of treatment that has yet been constructed. It covers an area of 97 acres, and is designed to serve an ultimate population of 1,340,000 persons distributed over an area of 78 square miles, which includes eight suburbs as well as a large section of the city itself. A still larger plant, known as the West Side plant, is in course of construction. It is to treat the sewage collected from an area of about 100 square miles, and to serve a population of 1,850,000 and a flow of 400 million gallons (American) daily. There are to be three batteries of Imhoff tanks, each comprising thirty-six units, 80ft. square and 35ft. deep, designed to give a detention of two hours. The eight skimming tanks will be 105ft. long, 66ft. wide, and 12ft. deep, and will provide a detention of 15 minutes. There will be four grit chambers, 90ft. long, 8ft. wide and 6ft. deep. The main pumping plant is to comprise seven centrifugal pumps, two of which will each have a capacity of 100 cubic feet per second—or, say, 54,000,000 gallons per day. Each will be driven by a 1000 horse-power motor. The other five pumps will be of double that capacity. All the pumps will have to operate against a head of 68ft.

France.

The problem of the Paris sewage disposal is still awaiting solution by the creation of a series of farms forming an extension of that already existing at Achères. The local opposition to the scheme is stronger than ever, and its execution would appear to be doubtful. Nevertheless, the Paris Municipal Council continues to push forward the scheme which provides for the laying down of mains from the decantation works at St. Ouen along the bank of the Seine and the installation of a plant at La Frette for pumping the residual sewage across the Seine to the proposed new sewage farms. The Council persists in this proposal because it is the most economical. The opponents point out that sewage farms have been abandoned in other great cities and declare that, with the experience it has gained for years past with small works laid out for the treatment of sewage by different systems, the Council ought now to be in a position to provide for the expenditure necessary to dispose of sewage in a manner less objectionable to the local populations. The difficulties have increased now that Paris is extending beyond its former boundaries and will probably cover, administratively, the Department of the Seine. That would mean the carrying out, eventually, of a much more comprehensive scheme of sewage disposal. At Sables-d'Olonne successful results have been achieved with a system of dealing with used water and sewage that was experimented with a few years ago in the suburbs of Paris. It is intended for sites where there is not a sufficient difference of level for the flow of used water by gravitation. The water and sewage are collected in a main in which a partial vacuum is created, and by the sudden opening of a valve the water is discharged into the sea. It is hoped to deal with household refuse in the same way, and experiments are being carried out in order to see whether it will be necessary, first, to crush the refuse.

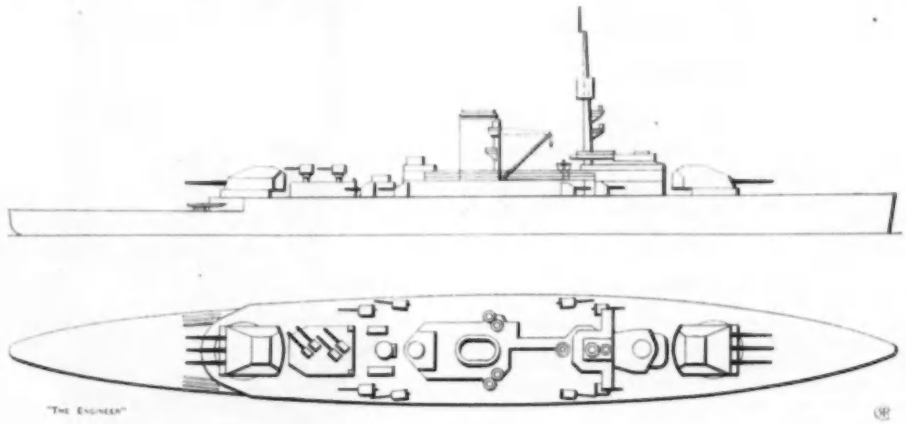
Water Pollution Research Board.

Towards the end of the year the Water Pollution Research Board issued a report setting out the work which it had done during its first year, *i.e.*, up to the end of June, 1928. The Board, which was appointed by the Lords of the Committee of the Privy Council for Scientific and Industrial Research, was constituted in June, 1927, as part of a comprehensive plan which the Government had formulated for dealing with the pollution of rivers and streams. It was followed by the setting up, by the Ministers of Health and of Agriculture and Fisheries, of an Advisory Committee on River Pollution, which was under the chairmanship of Sir Horace C. Monro, K.C.B., and which was referred to in our last Annual Article. The present document really consists of two separate reports. The first—or main—report, is signed by Sir Robert Robertson, K.B.E., F.R.S., the Chairman of the Board. It gives a general summary of the year's work under the following headings:—"General;" "Compilation of Information;" "Encouragement and Co-ordination of Research;" "Water Supply;" "Sewage Disposal;" "Industrial Effluents;" "Beet-sugar Factories' Effluent;" "Gauging of Rivers and Streams;" and "Visits." The second report is signed by Dr. H. T. Calvert—Chemical Inspector of the Ministry of Health—who was appointed part-time Director of Research at the same time that the Board was formed. The major portion of this second report is taken up with a discussion on the research which had been undertaken in connection with the effluent from beet-sugar factories. It mentions the investigations which had been carried out for the Department at the Rothamsted Experimental Station, and it enters, in some detail, into the experiments which were subsequently instituted at the beet-sugar factory at Colwich, near Nottingham of the Anglo-Scottish Beet Sugar Corporation, Ltd., which experiments are still in progress. Curiously enough, no mention is made of the method of treating the effluent, which was devised by the Institute of Agricultural Engineering, University of Oxford, though that method was evolved as the outcome of investigations carried out on behalf of the Ministry of Agriculture and Fisheries.

The Ersatz Preussen.

In our review of naval construction during 1928, reference was made to the German armoured ship, "Ersatz Preussen" (*i.e.*, replace ship for "Preussen"), which was authorised by the Reichstag last year and laid down at the Deutsche Werke, Kiel, in September. We are now able to give an amplified description of this truly remarkable vessel. There has been some debate in Germany as to whether she should be rated as a small battleship, an armoured cruiser, or simply as an armoured ship (Panzerschiff), which latter is the official designation. She is, in fact, a nondescript type, combining in some degree the offensive and defensive powers of a capital ship with the speed and sea-keeping endurance of a cruiser. In any case she represents an entirely new departure from current naval design.

With the exception of length, breadth, and draught,



PROFILE AND PLAN OF THE "ERSATZ PREUSSEN"

all essential particulars of the ship have now been released by the German naval authorities. As will be seen from the diagrams that we reproduce, from *Marine Rundschau*, she has rather fine lines, which seem scarcely adequate to support the relatively enormous weight of armament and armour that is to be carried. Restricted by Versailles Treaty rules to a displacement of 10,000 tons (which has, we notice, been interpreted in Germany as excluding fuel—or, in other words, as "standard" displacement), the German constructors have exhibited great ingenuity in economising weight. The hull of the ship is composed of the highest grade steel, and wherever possible light metals have been substituted for steel in the general equipment of the ship. Thanks to these expedients a net saving of 550 tons has, it is claimed, been effected in the construction of the hull.

Protection is very complete. There is an end-to-end belt rising to a considerable height above the water line, many of the armour plates being incorporated as elements of the hull proper; double armour decks are worked over vital spaces, and extensive subdivision has been adopted as a defence against underwater explosions. The freeboard is comparatively lofty, and the guns have a high command, which should enable them to be fought in rough weather. The main armament consists of six 11in. guns in triple turrets, with mountings permitting a high angle of elevation; eight 5·9in. guns behind shields, four 3·4in. A.A. guns in tandem; and six 19·7in. torpedo tubes on triple carriages, one at each side of the quarterdeck. The big guns are reported to have loading gear of a new pattern which enables a very rapid rate of fire to be maintained. Their utmost range is 30,000 yards.

Up to this point the characteristics of the "Ersatz Preussen" might seem to place her in the monitor or coast-defence ship category, but the details of her propelling plant show her to be designed for other purposes. She is to be driven by internal-combustion engines developing up to 50,000 B.H.P., the maximum speed being 26 knots. There is a good deal of mystery about these motors, which were designed by the engineering staff of the German Admiralty after a prolonged and costly series of experiments, and are now being constructed in the shops of the Maschinenfabrik Augsburg-Nürnberg. They appear to represent a great advance on existing I.C. practice, since it is officially stated that they develop a unit of horse-power for every 17½ lb. of weight. As the latest M.A.N. engines of which we have cognisance have a weight of 55 lb. per B.H.P., it is clear that the design of the new Admiralty type must possess some very novel features, the disclosure of which will be

awaited with keen interest by the engineering world.

The "Ersatz Preussen" is to carry sufficient fuel for a continuous voyage of 10,000 miles at a speed of 20 knots. Were not these figures vouched for by the German Admiralty, they would be almost incredible. We need hardly say that no vessel now afloat, whether man-of-war or liner, is able to steam anything like that distance at the speed stated. Our latest "County" cruisers have a maximum endurance of 10,400 miles, but only at an economical speed of about 13 knots. What the extreme radius of the "Ersatz Preussen" may be at economical speed can only be conjectured, but it may be as much as 18,000 miles.

All things considered, the German constructors have produced a noteworthy ship, the completion of which bids fair to mark an epoch in naval design. She will be unique in many ways, not least in respect of cost, since the estimate for the ship, complete with armament, is £4,000,000, or £400 per ton. Three further units of the class are projected. The appearance of these vessels may have far-reaching reactions on the international naval situation, for they will introduce a factor that was not contemplated when the Washington Treaty was drafted. In fighting power they are greatly superior to the Treaty class of 10,000-ton cruiser, they are faster than any existing battleship, and it is difficult to see how any vessel other than a battle-cruiser could deal with them. Possibly, therefore, the "Ersatz Preussen" may eventually necessitate some revision of the Treaty rules governing ship design.

Obituary.

JOHN CHRISTIAN LLOYD.

IT is with great regret that we have to announce that Mr. J. C. Lloyd, M. Inst. C.E., Engineer-in-Chief of the Great Western Railway, died in the early hours of January 3rd, following an illness which suddenly came upon him on December 12th last.

John Christian Lloyd, who was the son of the late Mr. E. H. Lloyd, formerly Divisional Engineer of the Great Western Railway at Neath, was articled to his father, and was appointed to the company's staff at Neath in 1888. In 1891 he was transferred to the Plymouth Divisional office to assist the then Divisional Engineer, Mr. Gibbons, in the special work preparatory to the conversion of the broad gauge to the narrow gauge, which was effected in May, 1892. Mr. Lloyd remained at Plymouth till 1898, when he became Resident Engineer at Cardiff. In that capacity he supervised extensive works at various places between Avonmouth and Tondu, including the Ely Valley and Western Valleys widenings. On January 1st, 1901, he was made Chief Assistant to the Bristol Divisional Engineer, and in 1906 was transferred to a similar position at Gloucester. On January 1st, 1911, he entered upon the duties of Divisional Engineer at Neath—the same position which his father had filled before him—and eight years later was transferred to Reading as Permanent Way Assistant to the Chief Engineer, thus succeeding Mr. Lionel R. Wood on the latter's retirement.

In November, 1921, Mr. Lloyd was appointed Assistant Chief Engineer to the Company, and, following the retirement of Mr. W. W. Grierson on January 1st, 1924, he, with Mr. W. Waddell, were nominated Joint Chief Engineers. Exactly two years later he became Chief Engineer.

Though Mr. Lloyd did not come much before the public eye, and though no outstanding railway work is associated with his name, he was pre-eminent as an administrator, and British railways in general and the Great Western in particular have, in his death, lost a fine permanent way engineer.

The "Fluidmeter."

A NEW type of fluid measuring apparatus has recently been put upon the market by Fluidmeters, Ltd., of Winchester House, Victoria-square, Birmingham. It is known as the "Fluidmeter," and it is made under the patents of Mr. F. S. Rippingille. It is claimed for it that it provides an economical and efficient means of checking and registering into and out of :—(*a*) Bulk storage ; (*b*) road and rail tank wagons ; (*c*) petrol pumps ; (*d*) fuel oil furnaces ; (*e*) Diesel engines, and many other uses, and that it will deal equally well with petrol, fuel oil, Diesel oil, tar, treacle, ammonia, lubricating oils—in fact, with liquids of all kinds. It is furthermore claimed for it that it is accurate to within one-half of 1 per cent., and that it is known on one occasion to have passed 5600 gallons with a total error of 1 gallon.

The apparatus is made in several sizes, and in several forms, depending upon the nature of the fluid with which it has to deal, but in all cases the principle of operation is the same. The working of the operating and recording mechanism will be readily understood by reference to the accompanying engraving. The meter comprises two chambers, an upper chamber A and a lower chamber B, which are separated from one another by a fluid-tight diaphragm C. In order that the component parts of the mechanism may be visible, half of the casing of the upper chamber has been removed. The fluid to be measured enters through the pipe D, which is in communication with the inlet valve E. This valve, when it is open, admits the fluid into the upper chamber A. The apparatus is controlled by the float F, which, when it is in its lowest position, opens the inlet valve E. When that is done the fluid enters the chamber A and gradually rises in it, carrying with it the float F. The latter slides on the sleeve G, which itself slides on an air shaft H. When the float F has reached a predetermined height, it moves the counting mechanism J on one step, and simultaneously closes the inlet valve E and opens the outlet valve K by lifting the sleeve G, which is connected by a system of links to both valves. The fluid in the upper chamber A can then pass down into the lower chamber B, the air shaft H permitting air to escape from the latter in order to allow of this. The fluid is then free to pass away by the pipe L. Two lock nuts M, working on a screw thread at the upper part of the sleeve G, limit the rise of the float and govern the accuracy of each stroke of the apparatus. It will be understood that if the position of these nuts be raised, the volume of fluid passed through the apparatus per stroke is increased, and *vice versâ*.

As the fluid passes away from the lower chamber B, the float F falls, and when it has reached a predetermined point, the outlet valve K is closed and the inlet valve E

THE "FLUIDMETER"

is opened. The cycle of operations is then repeated, the adjustments being such that the lower chamber is never entirely emptied, so that a continuous flow is ensured.

Additional claims made for the apparatus beyond those set out above are as follows :—(*a*) It is equally accurate with hot or cold liquids, and operates efficiently in any climate ; (*b*) it is unaffected by the rolling and pitching of a vessel at sea ; (*c*) it is not put out of action by such foreign matters as bits of waste or by the grit and bits of dirt, &c., which are always present in fuel oil ; (*d*) it does not register air ; and (*e*) it operates satisfactorily with either a continuous or an intermittent flow, viz., 5 gallons or 35,000 gallons per day, per month or per year. We are informed that one meter dealing with fuel oil has passed and registered over a million gallons since May last.

The apparatus is being made for Fluidmeters, Ltd., by Baker, Perkins, Ltd., of Peterborough.

MOTOR PINNACES FOR THE ROYAL AIR FORCE.

THE first of three new motor pinnaces which are being constructed for the overseas service of the Royal Air Force by Vosper and Co., Ltd., of Portsmouth, recently ran successful trials. A second boat was newly completed and the third will be finished by the end of this month. The boats are built to Admiralty design and each have a length of 56ft. with a beam of 11ft. 3in. and a depth amidships of 5ft. 4in. They have a maximum draught of 4ft. 4in. and are divided into four sections, namely, the cockpit, cabin, engine-room, and crew space, which is arranged forward. Water-tight bulkheads are provided at either end of the machinery space, and this space, together with the crew's quarters, is covered by a galvanised steel erection. In order to prevent impregnation of the hull timbers the boat bottom is copper sheathed and the engine-room is copper lined up to the water line. Each pinnace is propelled by a single four-cylinder reversible engine of the Gardner type having a total output of 96 B.H.P. at 370 r.p.m. The main engine drives a lighting dynamo, while an auxiliary oil engine is provided which is coupled to an air compressor, bilge pump and a dynamo for searchlight service. The fuel tanks are designed to give a large range of operation, and during the recent trials a mean speed of 10 knots was recorded. The pinnace was tested in fairly rough weather and she behaved well and was shown to be easy to manœuvre.

Motor Vessels and Marine Oil Engines in 1928.

No. II. (*conclusion*).*

Auxiliary Oil Engines.

A FEATURE of the year's progress was the technical advance made in the design of auxiliary oil engines for generator driving, emergency sets, and lifeboat propulsion. As recorded in THE ENGINEER of October 12th, Harland and Wolff, Ltd., installed in the Nelson liner "Highland Monarch," and other ships, auxiliary 50 B.H.P. per cylinder engines of a new design. Six cylinders were chosen instead of four, as giving better balance conditions, and the adoption of a comparatively long stroke and the chain drive for the cam shaft made for steady running with absence of vibration. In this new engine special attention was given to stiffness of bed-plate and columns and also ease of access for overhaul.

At Bedford, W. H. Allen, Sons and Co., Ltd., completed a large number of sets of auxiliary oil engines, both for motor vessels and for the C.P.R. "Duchess" class passenger liners, and these engines all embody special features. Many of the sets have an output of 300 kW, and are six-cylinder units, running at 300 r.p.m. with a cylinder bore of 13¾in. and a stroke of 18in. Again particular care was taken to balance the engine completely, and a bed-plate having a very stiff cross section is employed with the whole engine built in as few main castings as possible. The only three castings are the bed-plate and the two cylinder blocks. In this engine, also, the chain drive for the cam shaft is adopted.

In his Thomas Lowe Gray Lecture, which was delivered early in December and published in our issue of December 7th, Professor W. E. Dalby dealt with the possible vibration of a ship's hull under the action of an unbalanced engine. He indicated the fundamental problems involved, and mentioned some of the measures which had been taken by W. H. Allen, Sons and Co., Ltd., to overcome them. His suggestion that an investigation into the problem of hull vibration should be undertaken by a combination of shipbuilders, engineers, in conjunction with the Department of Scientific and Industrial Research was well received.

The manufacture of marine oil engines was extended during the year, and Mirrlees, Bickerton and Day, Ltd., designed a new type of engine and supplied seventeen sets. A full account of the Mirrlees auxiliary engine will be found in THE ENGINEER of March 30th, in which the 165-kW generator sets of the Holt Line cargo vessel "Eurybates" were described. A marine type of auxiliary oil engine was also designed and built by the National Gas Engine Company, Ltd., of Ashton-under-Lyne. Belliss and Morcom, Ltd., began work on several sets of auxiliary engines for the Holt Line, which are based on the design of the six-cylinder 600 B.H.P. engine described in THE ENGINEER of November 26th, 1926. At Barrow-in-Furness Vickers Armstrongs Ltd. completed some 300 kW light weight airless injection generator sets for marine auxiliary service on H.M.S. "Medway."

Airless injection oil engines of the Ruston Hornsby type were installed in vessels of the Houlder Line group, built and engined by the Fairfield Shipbuilding and Engineering Company, Ltd. In Glasgow good progress in the manufacture of auxiliary oil engines was made at the newly equipped works of Fiat British Auxiliaries, Ltd., Govan. Nine auxiliary generator sets, varying from 75 kW to 350 kW output, were delivered, and work on many others begun. A feature of the larger sets which ran successful trials before the end of the year, is the arrangement of the scavenging pump and the air compressor at opposite ends of the engine. With three working cylinders a five-crank arrangement is thus obtained with well-balanced qualities. Several sets of oil engine driven air compressors were also supplied.

A new four-stroke, single-acting, airless-injection engine, working with spring injection, was constructed by Davey, Paxman and Co., and was described in THE ENGINEER of September 21st.

For some years past the driving of refrigerating machinery aboard ship has been confined to the steam engine, and only quite recently have motor-driven compressors enjoyed any wide use. A departure from usual practice was made by Mr. R. T. Woods, the general manager of Nelson Lines, Ltd., in ordering for his new motor ships ammonia refrigerating plant with the compressors coupled direct to four-cylinder, single-acting, four-stroke oil engines. The oil engines were built by the Premier Gas Engine Company, Ltd., of Sandiacre, near Nottingham. They have a bore of 16½in., with a stroke of 24in., and are designed for an output of about 308 B.H.P. at 179 r.p.m.

A new type of lifeboat engine, which will run when submerged up to the air intakes, was described in THE ENGINEER of February 10th. It was built by the Weyburn Engineering Company, Ltd., of Elsted, to the designs of the Royal National Lifeboat Institution. The Parsons Oil Engine Company, Ltd., of Southampton, designed and built a new lifeboat

* No. I. appeared January 4th.

engine and supplied a large number of engines for lifeboat and emergency use.

High Elastic Limit Steel for Motor Ships.

In the discussions on Sir William Berry's note on Steel for Shipbuilding—see THE ENGINEER for June 9th—which took place at the Centenary Congress of the Institution of Civil Engineers, the fact was made known that, in the construction of the Holt cargo vessel "Eurybates," a saving in weight of 10 per cent. was achieved by using 50 per cent. special heat-treated "Martinel" steel in the hull. In five further motor ships which Alfred Holt and Co. have subsequently ordered, the same kind of steel will be employed, and even greater savings are anticipated. Towards the end of the year the "Martinel" Steel Company Ltd., of Liverpool, was formed to deal with the development work connected with the new steel, and several British steel makers will manufacture it under licence from that company. The new steel was also specified for the hulls of the two 24,000-ton Cosulich motor liners, "Saturnia" and "Vulcania," and it was possible to reduce the beam of the ships by 9in. by employing special heat-treated steel for the hull. "Martinel" steel has a tensile strength of 29–34 tons per square inch, with a limit of proportionality of 15 tons. A high tensile steel of 33–38 tons was also employed with success in three Ellerman liners. There is no doubt that such steels will be freely used in new ships, and Sir Westcott Abell suggested that the name of "dynamic" steel should be given to such materials, on account of their ability to resist live loads. We are informed that for a very large high-powered liner the saving in the power required, which would be brought about by the smaller displacement when a high elastic limit steel is employed on the hull, is such as to compensate for the extra cost of the steel, while the permanent saving of the smaller fuel consumption would, of course, continue.

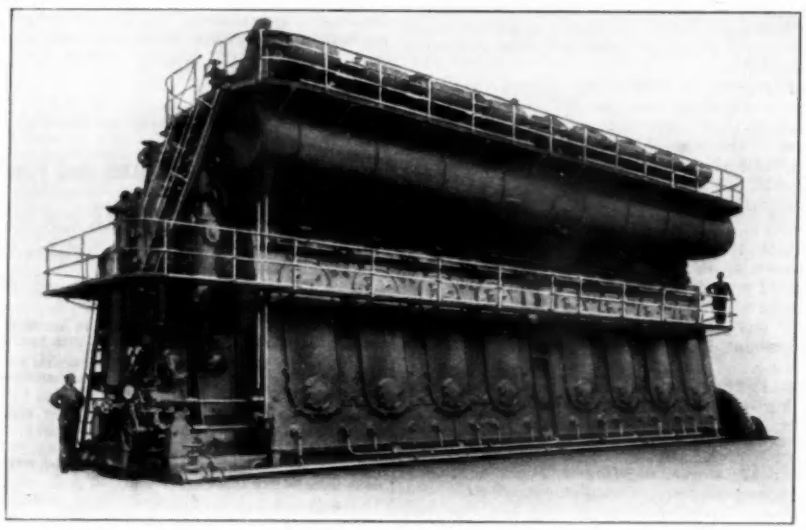


FIG. 8—7040 S.H.P. 8-CYLINDER SULZER ENGINE FOR M.V. "POELAU ROEBIAH"

General Progress Abroad.

In America further progress was made in the conversion of steamers to motor vessels under the Shipping Board programme, and in November Captain R. D. Gatewood, of the U.S. Navy, read a paper before the meeting of the American Society of Naval Architects and Marine Engineers, in which the operating results of twelve different ships were set forth and analysed. The engines included motors of the Busch-Sulzer two-stroke single-acting, the Worthington two-stroke double-acting, the M.A.N. double-acting two-stroke types, and both the single-acting and the double-acting Macintosh and Seymour four-stroke engines. In the eight further ships which are to be fitted with marine oil engines, some improvements based on service at sea are to be specified. Some initial difficulties were met with, but they were not found to be insurmountable, and the reliability of the larger sizes of American marine oil engines was demonstrated.

Three American steamships—the "Courageous," "Triumph," and "Defiance"—which had an original speed of 9½ knots, were lengthened 17ft., and modified in the fore part of the hulls and oil-electric machinery was installed, giving the ships, as reconditioned, a speed of 13½ knots. An interesting part of the work was the preparation of the seatings for the four Seymour and Macintosh four-stroke trunk-piston air-injection engines of 1200 B.H.P., which are employed to drive the 800 kW main generators and exciters. A specially deep 200 lb. rolled joist was used for the engine seatings, with, it is stated, excellent results. The two propelling motors of the twin-armature type each have a designed output of 2000 S.H.P. each, and were supplied by the General Electric Company and by the Westinghouse and Electric Manufacturing Company, respectively. The lengthening of the ships was carried out at the New Jersey Yard of the Federal Shipbuilding and Drydock Company, Ltd. A large number of American coastal, river and harbour boats, propelled by oil engines, were completed during the year.

A feature of motor ship construction in Germany was the large building programme of the Hamburg-America Line, which included several interesting engine types. In the "San Francisco" and her sister cargo ships, built by the Deutsche Werft, standard two-stroke M.A.N. double-acting engines of about 4000 S.H.P. were installed. This type of engine was modified during the year and an improved design of cylinder cover casing and framing which gives increased accessibility was adopted. For the land type engines, airless injection was brought into use, and was fitted on two 11,700 B.H.P. ten-cylinder engines built for a Berlin power station. Particulars of these engines will be found in THE ENGINEER of August 3rd. The design is one which will influence marine practice. A further geared motor ship, the "Monte Cervantes," was put into commission early in 1928. She is a 500ft., 14,000-ton liner, for the South American service, and was built by Blohm and Voss at Hamburg, who also constructed her M.A.N. type engines under licence. There are four 1500 S.H.P., 210 r.p.m. engines coupled through gearing to twin 75 r.p.m. propeller shafts.

In the two 16,000-ton, 16-knot Transatlantic liners, "Milwaukee" and "St. Louis," which are now well advanced, a similar type of machinery with 3150 S.H.P., 225 r.p.m. units will be adopted.

The first set of engines of the A.E.G. Hesselman airless injection type underwent trials early in the year, and was installed on the cargo vessel "Leverkusen." They are single-screw, six-cylinder, double-acting, two-stroke motors, with a designed output of about 4900 B.H.P. at 90 r.p.m. At trials, which took place in the Mediterranean Sea, a fuel consumption equal to about 0·36 lb. of oil per S.H.P. hour was obtained. The auxiliary engines on this vessel are also of the A.E.G.-Hesellman type, with airless injection. The Deutz Company supplied an eight-cylinder 1350 S.H.P. engine of the airless-injection type, which was described in THE ENGINEER of May 13th and 20th, 1927, for a Russian passenger vessel. About 28 motor ships were built and engined in Germany.

In Holland there was great activity in motor shipbuilding. In our issue of February 17th we described the Rotterdam Lloyd motor liner "Sibajak," which was built at the Royal de Schelde yards at Flushing, and equipped with two eight-cylinder De Schelde-Sulzer 5000 S.H.P. motors. At the same yard two 16,000-ton liners with Sulzer engines are to be built. A second large motor passenger liner for the Netherland Steamship Company was commissioned during the year. She is the "Christiaan Huygens," a 550ft. ship of 15,600 tons, and is propelled by twin-screw Sulzer engines of 11,600 S.H.P. total output. The ship was constructed by the Netherlands Shipbuilding Company at Amsterdam, and the machinery was built at Winterthur. Shortly before the end of the year the Netherlands Steamship Company placed orders for six more motor ships. Three sets of machinery for these vessels will be built at Winterthur, two sets by the Werkspoor Company under licence from Sulzer, while in the remaining ship single-acting, two-stroke motors of the Fijenoord-M.A.N. type will be installed. A notable series of ships, partly completed for the same owners, comprises the four 490ft. Dutch East Indies single-screw motor vessels—"Poelau Bras," "Poelau Roebiah," "Poelau Laut," and "Poelau Tello"—which are under construction in Holland and will be engined by Sulzers, of Winterthur. In Fig. 8 we show one of the single-screw units. It is an eight-cylinder engine, with a bore of 820 mm. and a stroke of 1440 mm., with a designed output of 7040 S.H.P., or close upon 10,000 I.H.P. at 100 r.p.m.

At Burgerhouts Shipbuilding and Engineering Company's works at Rotterdam, a four-cylinder Burgerhout-Nobel single-acting, two-stroke motor, having a designed output of 2000 S.H.P. was built and tested and installed in the tanker "Alexandre Andre."

Progress was made in Italy at both the Tosi Brothers works in Legnono and the Fiat factory at Turin. In the former works important experiments in supercharging on the Büchi system were carried out, and some ships were equipped with supercharged engines. The quadruple screw liner "Augustus" gave excellent service on the South American and North Atlantic routes, but she was laid aside some time, owing to defective piston-rods. A report of the metallurgical trouble has been prepared for publication.

Towards the end of the year the second Cosulich liner "Vulcania" was completed and ran successful trials. She is a sister ship to the "Saturnia," which was described in THE ENGINEER of October 7th, 1927. During her construction she was made suitable for the North Atlantic service of the company. She was built at Trieste by the Stabilimento Tecnico Triestino, and engined with Italian-built Burmeister and Wain type double-acting motors.

Both in Denmark and Sweden the Burmeister and Wain type of engine was installed in over twenty motor vessels. Messrs. Burmeister and Wain carried out experiments with a double-acting, two-stroke engine, operating with airless injection, and an order was placed for a vessel to be fitted with this new type of prime mover. Several of the ships were fast cargo-carrying vessels, with speeds up to 16 knots. The first set of eight-cylinder trunk-pistons working on the airless injection principle was fitted to the passenger vessel "C. F. Tietgen." Two sets of engines were built at Copenhagen for the new Swedish-American liner "Kungsholm," which was built by Blohm and Voss at Hamburg, and after successful trials took up her North Atlantic service at the end of the year. This ship is propelled by two sets of 7500 B.H.P. engines, running at 100 r.p.m., and both as regards her machinery and her hull and passenger accommodation the new liner is a remarkable ship.

During the year a very large programme of motor shipbuilding was embarked upon by Japanese owners, and, in new liners to be built in Japan, Burmeister and Wain four-stroke and Sulzer two-stroke types of engines are to be installed.

Railways in 1928.

NEVER since this particular article became a feature in THE ENGINEER have we had to record so little work done during the year by the British railways. The accuracy of this statement may be gauged by the fact that the chief engineer for the area that used to be covered by the North-Eastern Railway reports that no works worth mentioning have been carried out in his territory during the year. Yet, though there is little notable work to record, there are, nevertheless, among the four grouped companies, many activities of interest.

London, Midland and Scottish.

Among the new works noticed in our last Annual Article on page 37 of THE ENGINEER of January 13th, 1928, the following were completed during the year:—

Willesden.—The new engine shed, with twenty-three radial engine roads served by a 70ft. turntable. Two engine pits, each 65ft. long, have been provided outside the shed, and two double ash-lifting plants. A mechanical coaling plant remains to be completed.

Staveley.—The North Curve from Hall-lane Junction to the main line, doubling the line thence to Seymour Junction, additional sidings and a new marshalling depôt—all involving 120,000 cubic yards of excavation and 12 miles of permanent way.

Chevet Junction and Snydale Junction Widening.—This was the conversion, from two to four lines, of 3¾ miles of railway and the opening out of Chevet Tunnel, 702 yards long.

Oakenshaw and Crofton Connecting Line.—This line allows loaded coal trains from the former Midland line at Oakenshaw to join the old Lancashire and Yorkshire at Crofton, and proceed thence to Goole. It necessitated the removal of 32,000 yards of earthwork.

Horbury and Wakefield Widening.—This was the conversion of a length of 3½ miles from two to four lines. It included the opening out of Horbury Tunnel, 130 yards long, and the provision of a new station.

Progress was made with the following works, to which reference was made a year ago:—

Tilbury.—The sub-structure for the circulating area of the remodelled station was completed, and contracts were placed for the structure itself and for the station buildings, &c.

New Railways and Extensions in Nottinghamshire.—In addition to the Chipstone Colliery branches and that to serve the new Welbeck Colliery, mentioned in our last Annual Article, there is quite a large amount of work being done at other points in Notting-

hamshire, particularly on what is known as the Southwell branch, *i.e.*, the branch line between Rolleston Junction on the Nottingham–Lincoln line and Mansfield.

The branches at Clipstone Colliery—one 3 miles in length and the other ½ mile—are practically completed. That to Welbeck Colliery is 3¼ miles long, and necessitated the removal of 140,000 cubic yards of excavation and the erection of five bridges. The permanent way is being laid.

The first work to be noticed on the Southwell branch is a new curve from the Nottingham–Lincoln line at Rolleston Junction, so as to give access to and from Nottingham. It is 1 mile 6 chains in length, and will shortly be completed. The existing single line from Rolleston to just south of Southwell Station is being converted into a double line. This work is also approaching completion. At Kirklington, the next station north of Southwell, the passing loop on the single line there has been lengthened. Considerable improvements have been necessary at both Rufford Colliery Siding and Mansfield Colliery Sidings—on the same branch—and they are nearly finished. Additional siding accommodation is also necessary at Shirebrook, north of Mansfield, and is in hand.

Mid-Notts. Railway.—This is a joint undertaking of the London, Midland and Scottish and the London and North-Eastern companies in the same vicinity. Work upon it will be soon begun.

Manchester : Victoria and Exchange Stations.—The work of joining up these adjacent stations under one roof approaches completion.

Longbridge and Barnt Green Widening.—This is another conversion from two to four lines, including the opening out of a tunnel The widening is 2¾ miles in length and the tunnel 440 yards long and 80ft. deep. More than 500,000 cubic yards of excavation were involved, as well as the widening of five bridges. About 140 yards of the tunnel have still to be opened out, and it is expected that the widening will be completed by next summer.

Among the works begun during the year there were :—

London : Broad-street.—To allow the Southend trains to use this station, Nos. 1 and 2 platforms are being extended by about 260ft. in order to give them a length of 700ft. The actual extension is done and the roofing approaches completion.

Liverpool.—Additional siding accommodation is being provided at Edge Hill. About 67,000 cubic yards of excavation have to be removed, of which about one-half has already been conveyed to Speke, where additional reception, sorting and storage sidings are being provided for the increased timber traffic through Garston Dock. Several of the new storage sidings and their stacking grounds are in use.

Goole.—Very extensive changes are being made for dealing with coal for shipment. There are to be two additional reception lines, and seven loaded wagon sidings, and a group of dead-end sidings are to be converted into double-ended, with a reception line and shunting neck. Some 56,000 cubic yards of filling are required, of which 49,000 cubic yards have been tipped.

London and North-Eastern.

Among the new works mentioned herein a year ago the following were completed in 1928 :—

Harworth Colliery Branch.—This work has involved the construction of a branch from the South Yorkshire joint line and a connecting line from the London and North-Eastern Company's own Firbeck branch to the new line to the Harworth Colliery.

Bilsthorpe Colliery.—Construction of a branch 3 miles 10 chains long.

Mansfield.—The additional sidings at Clipstone Junction to accommodate a further 1200 wagons.

Frodingham.—The works at this place have been necessitated by increased ironstone traffic. They include a new curve, marshalling yard with accommodation for 2000 wagons, and a rebuilt passenger station.

Progress as follows was made with the following works :—

Blidworth Colliery.—It was stated a year ago that it was hoped to complete this branch, 2 miles 13 chains long, soon after the neighbouring Bilsthorpe Colliery branch. As the pit, however, is closed temporarily owing to bad trade, the work was stopped after the completion of the bridges and earthworks.

Whitemoor.—A new marshalling yard near March will very soon be brought into use. It contains ten reception roads, each accommodating trains of eighty wagons. The trains, on arrival, will be humpshunted into forty sorting sidings, having a total capacity of 3679 wagons. The novel features at this place will be the Froelich wagon retarders for automatically braking the wagons as they enter the siding, and the automatic electrical operation of the siding points.

Hattersley Tunnels.—These two tunnels are respectively 100 and 264 yards in length and are separated by an opening of 110 yards. They are being opened out and about one-third of the total of 700,000 cubic yards of material has been removed.

Clacton-on-Sea.—The contract for the reconstruction of the station at Clacton was let during the year, and the work was begun.

Great Western.

The following work, noted a year ago as in hand, was completed :—

Cardiff, Queen-street.—This contract included the provision of a running junction between the Rhymney and Taff Vale sections—in order that Rhymney line trains may enter the Queen-street, Taff Vale, Station—a new down relief line platform, and the conversion of the former down platform into an island platform.

Certain works, which have not previously been mentioned, were completed. They are :—

Conversion from Double to Single Line.—The Rhydyfelin branch, as from Whitchurch, 6½ miles long, and that part of the former Midland and South-Western Junction Railway lying between the junction with the Great Western main line at Andoversford Junction and Cirencester, a distance of 14 miles, have been converted from double to single line.

Dawlish.—The Colonnade Viaduct, which was of nine spans, varying from 11ft. to 13½ft., has been replaced by a structure of three spans, which has greatly added to the amenities of the town's approach to the sea.

The undermentioned works were alluded to in our review a year ago. They made the following progress :—

Paddington.—The second instalment of the reconstruction of the goods station approaches completion.

Bristol, Temple Meads.—The enlargement of the goods depôt is practically finished.

Saltash, Royal Albert Bridge.—The land spans of this masterpiece of Brunel needed reconstruction. Work on the seven on the east side of the main structure was finished, and the ten spans on the west side are now being dealt with.

Newport, Mon.—An important improvement to the passenger and goods accommodation, including a new carriage shed and sidings at Ebbw Junction, are being proceeded with.

Swansea, High-street.—Since our notice a year ago the platform coverings, new bridge approach to the goods yard, the reconstruction and widening of the bridge over "The Strand" and the carriage sidings have been finished. The main work that remains to be undertaken is the station buildings.

The following new works were started during the year :—

Ponsanooth Viaduct is on the Falmouth branch. It is of eleven spans, of a total length of 650ft., and of timber. Its replacement by one of masonry and concrete is in hand.

St. Erth and Marazion.—The conversion of this length, of about four miles, from single to double line.

Crumlin Viaduct consists of ten spans, each of 150ft. The iron decking is being strengthened.

Southern.

The following works, mentioned a year ago, as in progress, were completed during the year :—

Southampton.—Reconstruction of the Town Station and the enlargement of the South-Western Hotel.

Ryde.—A new station at Ryde Pier, together with the remodelling and improvement to the buildings, of the Esplanade Station and of the passenger station at St. John's-road,

St. Helens, Isle of Wight.—Reconstruction of wharves in reinforced concrete for a length of 800ft.

Dover.—Demolition of the Archcliff Fort and the provision of a reinforced concrete engine-shed, 360ft. long by 107ft. wide. The old timber viaduct between the fort and Shakespeare Tunnel has been filled in, a concrete seawall, 1000ft. long, has been built, and a public promenade constructed.

Victoria.—Covering in of the carriage sidings for a length of 750ft. and width of 150ft., and use of the new building as a carriage cleaning shed for steam-worked stock. A new shed, for a similar purpose, has been provided at Clapham Junction.

Other works noted in our last annual article are still in hand, and others were begun during the year. Their progress is as follows :—

Wimbledon.—The greater part of the reconstructed platforms were brought into use and roofed in. The station buildings are in active progress, and it is hoped that they will be completed by the coming summer.

Wimbledon and Sutton Railway.—This new line will be 5 miles 20 chains in length. Its construction is proceeding rapidly, and it is expected that the first portion—of about 1½ miles and including stations at Wimbledon-chase and Merton South—will be opened by midsummer.

Epsom.—The station at the junction between the Central, or Brighton, section main line and the Western section Raynes Park branch has hitherto only been available for trains from and to the latter line. It is being rebuilt and provided with two island platforms, each 650ft. long, so that all trains may use it. It will be completed in time for the opening in March of the third stage of the electrification, and the Epsom Town Station on the Central section will be closed.

Lewisham.—Two new connecting lines at this point will allow for exchange goods traffic between the Northern railways and Hither Green to avoid the crowded lines through London Bridge Station. That between Lewisham and St. John's necessitates a concrete and steel viaduct and a skew, steel bridge over the line to Hither Green. The work is being actively pushed forward.

Kent House and Beckenham Junction Widening.—This work involves not only the provision of two additional running lines but the raising of the tracks and a consequent improvement of the gradients. The work is nearly completed, and it is intended to reopen the Norwood Spur line into Beckenham Junction in March in connection with the third stage of the electrification.

Newhaven Harbour.—The reconstruction of the east pier in reinforced concrete was completed for a considerable portion of its length of 1500ft.

Electrification.—The conversion of the electrical operation in the Central, or Brighton, section from overhead alternating-current to third rail direct-current and of the provision of electrical equipment on practically all the remaining lines in the London area is being carried out in three stages. The first stage involved 106 miles and was opened on March 25th, and the second, of 67 miles, on June 17th. It is intended to complete the work in March next. In consequence of a rearrangement of the lines approaching London Bridge a new position had to be found for the station at South Bermondsey. Platform extensions were necessary at seventeen stations. A new carriage-cleaning shed, 600ft. long by 186ft. wide, was opened at Selhurst. One of the most interesting features in connection with the electrification is the provision of colour light signalling between London Bridge and Bricklayers' Arms and the opening of a large all-electric signal-box at London Bridge.

Underground.

The great event of the year was the opening, on December 10th, of the new station in Piccadilly-circus. The work was started in 1925 and has cost over £500,000. The stations, at three different levels, at Charing Cross are being rearranged, and a new booking-hall at the street level provided, together with improved escalator service. There are now eight escalators at Charing Cross.

CALENDARS, DIARIES, &c., FOR 1929.

ASHWELL AND NESBIT, Ltd., Barkby-lane, Leicester.—Wall calendar with daily tear-off slips.

BLACK AND DECKER, Ltd., Slough, Bucks.—Wall calendar with monthly tear-off sheets.

BRITISH OXYGEN COMPANY, Ltd., Upper Edmonton, London, N. 18.—Copy of the firm's daily reminder.

BURTON, GRIFFITHS AND CO., Ltd., 64–70, Vauxhall Bridge-road, London, S.W. 1.—Wall calendar with monthly sheets.

CHEMICAL TRADE JOURNAL AND CHEMICAL ENGINEER, 265, Strand, London, W.C. 2.—Wall calendar with monthly tear-off sheets.

COUNTY OF LONDON ELECTRIC SUPPLY COMPANY, Ltd., County House, 46–47, New Broad-street, E.C. 2.—Telephone card.

CROMPTON PARKINSON, Ltd., Chelmsford.—Wall calendar, three months to a sheet.

FLOWERDEW AND CO., Ltd., 227, Strand, W.C. 2.—Calendar with monthly tear-off sheets.

B. J. HALL AND CO., Ltd., Shell Corner, Kingsway, London, W.C. 2.—Wall calendar with monthly tear-off sheets.

R. AND W. HAWTHORN, LESLIE AND CO., Ltd., Forth Bank Works, Newcastle-on-Tyne.—Wall calendar with monthly and daily tear-off slips.

HOLMAN BROS., Ltd., Camborne, Cornwall.—Wall calendar with monthly tear-off slips.

HOPKINSONS, Ltd., Huddersfield.—Refill date cards for moving ring calendar.

KENRICK AND JEFFERSON, Ltd., West Bromwich.—Calendar with daily tear-off slips.

LANCASHIRE UNITED TRANSPORT AND POWER COMPANY, Ltd., Atherton, Lancs.—Wall calendar with monthly tear-off slips.

LEA RECORDER COMPANY, Ltd., 28, Deansgate, Manchester.—Copy of appointment calendar.

MACHINERY AND TECHNICAL TRANSPORT, Ltd., 4 and 5, Copthall-court, London, E.C. 2.—Wall calendar with daily tear-off slips.

PECKETT AND SONS, Ltd., Bristol.—Wall calendar with monthly tear-off slips.

PETTERS, Ltd., Yeovil.—Wall calendar with monthly tear-off sheets.

PRIEST FURNACES, Ltd., 123, Albert-road, Middlesbrough.—Refill for desk calendar.

CHARLES ROBERTS AND CO., Ltd., Horbury Junction, near Wakefield.—Rail and road calendars with daily tear-off sheets.

J. SAGAR AND CO., Ltd., Canal Works, Halifax, Yorks.—Wall calendar with monthly tear-off sheets.

SENTINEL WAGGON WORKS, London and Shrewsbury.—Wall calendar with monthly cards.

SIEMENS AND GENERAL ELECTRIC RAILWAY SIGNAL COMPANY, Ltd., Central House, Kingsway, W.C. 2.—Wall calendar with daily tear-off slips.

STANTON IRONWORKS COMPANY, Ltd., near Nottingham.—Pocket diary.

STAVELEY COAL AND IRON COMPANY, Ltd., near Chesterfield.—Pocket diary.

TANGENT TOOL ENGINEERING COMPANY, Ltd., Tangent Works, Keynsham, near Bristol.—Wall calendar with daily tear-off slips.

URQUHART LINDSAY AND ROBERTSON ORCHAR, Ltd., Blackness Foundry, Dundee.—Wall calendar with monthly tear-off slips.

WELIN-HIGGINS COMPANY, Ltd., Morley House, 314–322, Regent-street, W. 1.—"Fabrikoid" calendar with daily tear-off slips.

WELIN-MACLACHLAN DAVITS, Ltd., Hopetoun House, Lloyd's-avenue, London, E.C. 3.—Refill for desk calendar case.

EDWARD WOOD AND CO., Ltd., 81, Cannon-street, E.C. 4.—Pocket diary.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

January Quarterly Meeting.

THERE was a large and representative gathering on 'Change in Birmingham to-day—Thursday—on the occasion of the first quarterly meeting of the Midland iron trade for the year 1929. Practically all districts of the kingdom had sent their agents to feel the pulse of this market, and gauge, if possible, its prospective business possibilities. For some time past the Midland material market has been slack, supplies exceeding the effective demand, and values being on the easy side. It was hoped that the New Year would bring increased enterprise on the part of consumers of iron and steel, and that they would leave behind with the Old Year their policy of hand-to-mouth buying. Producers to-day were extremely anxious to fix up long-date contracts, but although there was a certain amount of forward buying, it had not, up to the time of writing, come up to makers' anticipations. Consumers were cautious. They needed to assure themselves that they were more likely to gain than to lose by contracting beyond their immediate needs, and they approached producers with the idea of securing special terms. It rests to some extent with how far each side is prepared to meet the other; whether bulk contracting is revived this quarter, or whether the method of buying just sufficient to cover current requirements is persisted in. It has to be remembered that at the moment it is only in a few specially favoured departments of industry that there is any considerable accumulation of orders, and buyers of raw material have, to a great extent, if they buy forward, to forecast their future requirements. The year just passed produced such an irregular flow of business that manufacturers are chary about relying upon even the present evidences of improvement in trade, and feel they must have definite contracts on their books before they can venture to contract forward for material. Nevertheless, the tone of the quarterly meeting was bright, and there were early evidences of a desire on the part of both producers and consumers to do business if it were at all possible. Reports from various manufacturing centres were in optimistic vein, and one gathered that at least a continuance of steady progress and the consolidation of the ground gradually won by persistent effort, is looked for during the next three months. It is not considered likely that there will be any spectacular market activity or industrial trade boom, but it is agreed on all hands that existing conditions are propitious for a steady improvement in trade generally throughout the Midlands and Staffordshire.

Pig Iron.

Buyers of pig iron, relying to some extent upon the accumulation of stocks at the furnaces produced while consuming works were on holiday, came to the quarterly meeting with the idea of buying foundry material at cheaper rates than those lately ruling. Smelters, however, showed a more united front than they have done at other times, and the probability was that, failing an agreed reduction by makers, buyers would be disappointed in their efforts to get price concessions. The market opened with Derbyshire smelters quoting No. 3 foundry material £3 at furnaces and forge £2 15s. Northamptonshire foundry was quoted £2 16s. and forge £2 11s. 6d. Smelters hardly expected to realise these figures, but, as in recent weeks, they have used these prices as a starting point and conceded about 1s. per ton. Pig iron producers anticipate an early reinvigoration of consumptive demand, and they express their intention further to curtail production rather than accept prices which leave them no margin of profit. Consumers appeared equally determined not to place extensive business at present rates, and the outcome of the struggle is awaited with more than customary interest. The Midland foundries are moderately engaged, but the forges have little work on hand. A betterment of last year's position is, however, expected, in both quarters in the near future. Hematite from North-Eastern makers was on offer at £3 10s. to £3 11s. for mixed numbers.

Steel.

Demand for finished steel is restricted to small lots of 20 or 30 tons, and competition is keen even for these small lots. Prices continue at £7 17s. 6d. for joists and angles, and £8 12s. 6d. for plates, subject to the usual rebate to consumers who promise to use nothing but English steel. Steel hoops are £10 and boiler plates £9 15s. Consumers of half-products are apparently well supplied for the present, and are not inclined to commit themselves further until they can take the measure of the new situation. The re-rollers are still competing with the foreigners on advantageous terms for a great proportion of the business accruing at home. They anticipate the reappearance of Belgian competition. There have been premonitory symptoms in the form of freer quotations and the promise of quicker deliveries, but the menace has not so far assumed serious proportions. Compared with native makers' prices, continental quotations are not sufficiently attractive. Re-rollers of small bars ask £7 15s. for ordinary specifications, and billets are named £6 5s. upwards. There is no great volume of business in the steel department at date, but better things are hoped for. The improvement in shipbuilding on the Clyde and the North-East Coast is an encouraging feature in the trade. Midland rolling stock firms have secured some good foreign contracts recently, and from these and other quarters improved calls for steel are looked for before the quarter is very old.

Finished Iron.

The Staffordshire iron trade has made a fairly good start in the marked bar section, but in the Crown and common bar branches mills could do with considerably more work. Lack of activity in the building of goods trucks is a serious business for the nut and bolt trade of the Black Country. Merchants handling steel and iron bars used by nut and bolt makers cannot get specifications. In the chain trade the outlook is improving. The position at the moment for heavy cables is little better than at this time last year, but with the likelihood of greater activity in the shipyards the prospects should undoubtedly revive. The outlook in the small chain trade for general engineers does not hold out the same promise, due to the persistent depression in the mining industry and its effect on the general engineering industry. The tube works, though complaining bitterly of the severity of continental competition, are maintaining a fair output and considerable quantities of iron tube strip are being purchased. There is a tendency for values to decline slightly, however, and some business was put through this week at £10 12s. 6d., which is half-a-crown lower than the recent ruling rate.

Galvanised Sheets.

There continues to be a good and regular demand for galvanised sheets, and Midland producers have now sold the greater portion of their output over the next two months. Bookings are now being made for March delivery. Prices are firm on the £13 10s. basis. Half-a-crown and in some cases 5s. more is fairly generally required for small tonnages for home consumption.

Scrap.

Heavy steel scrap is in moderate demand, the best price obtained by Birmingham merchants apparently being £3 9s. delivered South Wales.

Rolling Stock.

Birmingham rolling stock builders are to be congratulated upon their most recent success. In competition with Germany and Holland, they have received an order for thirteen self-propelled steam rail cars for service on the Egyptian State Railways. The British quotations generally were considerably less than those from the Continent, and the tender of £66,784 of the Birmingham company was the lowest of the seven submitted. The contract was, therefore, secured by the Birmingham Railway Carriage and Wagon Company, Ltd., of Smethwick, with whom the Yorkshire Patent Steam Waggon Company, Ltd., of Hunslet, Leeds, will be associated as the builders of the engine and boiler units.

Works Extensions.

News of the extension of factories in the Midlands continues to come to hand. This week it is in the motor engineering branch of industry that expansion of manufacturing space is reported to be required. Big new steel-framed factories, capable of doubling the firm's output are to be constructed for Maudslay Motors, Ltd., at Coventry. An order for £20,000 worth of machine tools to equip the new buildings is said also to have been placed. Large works additions to give 50,000 square feet more manufacturing space are being undertaken by a Midland firm for New Imperial Motors, Birmingham.

Cannock Chase Coal.

There was a loss of one-fifth of a penny per ton on all coal produced in the Cannock Chase area in November, compared with a profit of 5·84d. per ton in October. During the preceding ten months, however, losses were recorded as follows:—December, 9·32d.; January, 0·93d.; February, 5·35d.; March, 5·12d.; April, 6·15d.; May, 1s. 1·65d.; June, 2s. 1·47d.; July, 1s. 9·47d.; August, 1s. 0·72d.; September, 2·57d. It will therefore be seen that there was only one profitable month in the twelve, and the accumulated deficit of the owners now amounts to £2,701,915. The miners' wages for January, based on the ascertainment for September, October and November, will remain at the minimum of 42 per cent. on the 1911 basis rates; but the owners' real ability to pay is only 21·62 per cent.

Mines Drainage Bill Dropped.

Owing to lack of funds, the Bill which was recently promoted to abolish the South Staffordshire Mines Drainage Commission has been abandoned. The decision to seek parliamentary action resulted out of proceedings taken in the High Court by the Commissioners against a colliery proprietor, for the recovery of money due in respect of coal raised in the Tipton area during the general strike. Respondents contended that as the Commission had ceased to render any service to the area by raising water, it was not entitled to recover the rates which the plaintiffs held they were legally empowered to impose. Local coalowners then took steps to deprive the Commissioners of their legal authority, and a Bill was promoted. The promoters, however, have been unable to raise the funds to carry forward the measure, and consequently the position will remain unchanged.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Electricity for Industrial Purposes.

A FAIR measure of support by electrical engineering firms has been accorded to the Industrial Electric Heating Exhibition, which is being held this week at Belle Vue, Manchester. The Exhibition, which includes demonstrations of electrical appliances of various kinds, has been organised by the Electricity Departments of the Manchester and Salford Corporations and the Lancashire Electric Power Company, in conjunction with the British Electrical Development Association. One of the most impressive and not the least interesting of the exhibits is an induction furnace for smelting steel, with an hourly capacity of about 6 cwt. of high-grade crucible steel. An electrical appliance for heating rivets to the extent of nearly 1000 an hour with a low current consumption is another interesting feature of the show, as are also the furnaces employed in the hardening and tempering of needles, and in the finishing of motor-car parts, electric-welding appliances, electrode boilers for a wide range of industrial purposes, an electrical paint-burner to supersede the blow-lamp, and a variety of other types of apparatus, the purposes of which are as far apart as the ripening of bananas and the conditioning of cigars.

Manchester-Altrincham Electrification Scheme.

The scheme for the electrification of the line between Manchester (London-road Station) and Altrincham, a distance of roughly nine miles, is now approaching the practical stage. The line is controlled jointly by the London, Midland and Scottish and the London and North-Eastern Companies, and was formerly known as the Manchester South Junction and Altrincham Railway. The engineering details in connection with the scheme have now been worked out, and it is understood that tenders will be invited in the near future. It is expected that the work of electrification will take about two years to complete.

Locomotives for South Africa.

An interesting feature of the work now passing through the shops of Beyer, Peacock and Co., Ltd., Gorton, Manchester, is two Garratt locomotives for goods service on the South African railways. When completed in five months' time they will weigh about 220 tons each, and have a length of 90ft. The locomotives are to be mechanically stoked, and are said to be able to haul a load of 3000 tons up a gradient of 1 in 100 on the track gauge of 3ft. 6in., for which they have been designed. The contract price of each engine was £14,500.

New Bridge for Old.

The task of substituting a 150-ton steel bridge for a smaller structure over Park-road, Stretford, Manchester, on the Cheshire Lines Railway, was successfully carried out by Thomas Wrigley, Ltd., of Manchester, last Sunday morning. A start with the removal of the old bridge was made at 7.30 a.m., and the new structure was in position, the lines relayed, and the first train had passed over before 11 a.m. The new bridge was constructed alongside the railway track by Pearson and Knowles, Ltd., of Warrington.

Airway Hitch.

Manchester's plans to establish an air port at Chat Moss, a site which was approved some months ago by officials of the Air Ministry, are not going through without a hitch. A meeting of the Aerodrome Committee of the City Council was held on Monday of this week to receive the city surveyor's estimates of the cost of laying out the aerodrome. Later it was officially explained by the chairman of the committee, Councillor William Davy, that the cost was greater than had been at first thought owing to the insistence of the Air Ministry that two concrete runways should be constructed, each 100ft. wide and 200ft. long. The contention of the committee is that until some indication is available as to the commercial possibilities of the air-port one runway should be sufficient, and an interview with a representative of the Air Ministry with a view to effecting a compromise on these lines is being sought.

New Berth for Liverpool.

A 350ft. berth, with railway lines and cranes, is to be installed at Carriers' Dock, Liverpool, to facilitate direct transport from ships to railway wagons.

Non-ferrous Metals.

The past week in the non-ferrous metals market has been a period of only minor events so far as price fluctuations are concerned, none of these being of an important character, though a considerable loss has been experienced in the spelter section. Both tin and lead, however, are higher on balance than they were at last report. In the case of tin, a fair amount of buying interest has been shown, but at one period the feeling was distinctly bearish, and on a weakening of the statistical position values closed last week-end at a very low level. There has since, however, been a marked rise in prices, and at the moment the position appears to be reasonably steady, so far as one is justified at any time in so describing the tin market. Interest in copper on the part of consumers shows no sign of abating, and the continued relative shortage of available supplies of the metal is responsible for a strong undertone, although on balance standard cash is a shilling or two cheaper on the week. A certain amount of profit-taking in spelter has had its influence on prices, but values at the time of writing represent an improvement over the worst, the loss on the week being between 5s. and 10s. a ton. On the whole, lead has been the subject of a fair weight of business, and prices have improved to the extent of about 5s. a ton.

Iron and Steel.

Although there has been no marked revival of buying interest in foundry iron on this market since the holidays, the price position is coming in for renewed attention. Makers are seeking to cover themselves to some extent for the higher costs of production resulting from the advance in coke. Although no general addition to pig iron prices has yet been made, there has been at least one attempt on the part of a Midland maker, and it is possible that a move in this direction by Derbyshire and Staffordshire producers will be made in the near future. In steel, constructional engineers are purchasing comparatively limited quantities on a strictly early delivery basis. So far, the improvement in the outlook for this branch of engineering has not reacted on the steel market, though some influence in this respect should be experienced before long. Apart from boiler-plates, which have firmed up a little—less from any improvement in the call for them than from a desire on the part of rollers to enforce more remunerative terms—there has been little alteration in the price situation. Acid boiler-plates are now at about £9 17s. 6d. per ton, and basic qualities at £9 12s. 6d. There has been a little more inquiry about in the market for

imported iron and steel, and there are indications that the falling tendency which has been in evidence of late has been halted for the time being, at all events.

BARROW-IN-FURNESS.

Hematite.

If anything there is a better tone in the hematite pig iron market in this district. It has developed during the past week, and there is a more optimistic feeling generally. Makers have booked orders which promise more activity than was the case a year ago. There is a more general tendency to place orders for forward delivery, and the number of inquiries which are coming in is very assuring. Trade to-day is better than it has been for many months, and, what is more, there is a feeling of greater confidence as to the future than there has been for some considerable time. If the steel works continue active, and their requirements for iron are considerable, then it is possible that should the demand further increase another furnace or two may be put in blast. Makers will, however, be very wary as to this step, and will not increase the output unless they are certain of a fairly long run. The demands on steel account will be the deciding factors. Special qualities of iron are experiencing a good market. The iron ore trade shows promise of better things as the outside demand is likely to improve. Foreign ore is being imported in steady tonnage. The steel trade is not very good yet. It is true that certain orders have been booked, but they are not heavy, and the contracts held do not assure any of the departments a steady run for a long period. The rail market is not very bright, and there is very keen competition for orders. The hoop mills at Barrow are well situated for orders, and are assured of a steady run.

SHEFFIELD.

(From our own Correspondent.)

Condition of the Steel Trade.

ALTHOUGH there is an optimistic feeling of confidence in regard to the steel trade of the Sheffield district, it is difficult to point to any definite or substantial indication of improvement. It is a fact which cannot be overlooked that the number of men out of employment through trade conditions is greater than it was at this time last year, and although some firms and departments are fairly busy, other sections are still experiencing great difficulties. The number of furnaces in operation in the district has remained unchanged for a considerable time, and whilst some firms had a sufficiency of work to commence after the week's holiday at Christmas, there is no prospect of an immediate increase in work or of the receipt of orders of the quantity which used to be received in time for execution during January. The big rail and billet mill at the Ickles works of the United Steel Companies has been closed, and only a few of the furnaces are in operation. It would seem that the management of the companies is carrying out a policy of rationalisation by transferring activities from Ickles to Stocksbridge. On the other side of the picture, it should be mentioned that the great works at Templeborough are well employed, and there has been some increase in railway work for axles, tires, and springs. There continues to be a good demand for soft steels, although no increase is noticeable. The light castings and engineering foundries are as depressed as ever, and firms engaged in ironworking state that there are no signs of an improvement in conditions. Up to the present there has been no revival in the demand for the best acid steels.

North Lincolnshire Developments.

There are signs of improved trade and good prospects in the North Lincolnshire district, and steel furnaces are to be restarted at the Redbourne Hill Works of Richard Thomas and Co., Ltd., tin-plate manufacturers of South Wales. These works, which were erected for supplying sheets and bars for the tin-plate trade, were closed when it was found that this material could be imported cheaper than it could be manufactured, but now they are being reopened through what is really a reversal of conditions. The company has been importing 1500 tons of steel per annum for its Welsh works, but with the decline of foreign competition it is possible for this material to be supplied by the Redbourne Hill Works. It is not expected that the furnaces will be in operation again until nearly the end of March, but the chairman of the company has hinted that there may be extensions of the plant for working up an important quantity of the products of the furnaces into finished steel material. The desirability of manufacturing something beyond pig iron, steel blooms and billets, tin-plate and steel bars is, it is believed, being considered by the directors. Generally speaking, the Lincolnshire steel trade, compared with that of other districts, has had a fairly good year, with no abnormal amount of unemployment.

Railway Orders.

Although, as previously stated, there has been some increase in railway work and there is a prospect of an increase in it in the near future, there has been no response to the appeal recently made by manufacturers to the railway companies, asking them to discontinue or modify their manufacturing activities. Two of the large railway companies have invited the usual tenders for supplies of steel material and various stores for twelve months, but the general policy of rigid economy is being continued, and the L.M.S. Company is not inviting tenders this year, as it holds unused stocks from last year's deliveries. There is some consolation for manufacturers in the prospect that the demand from overseas, particularly from South America, should be in excess of last year's demand.

Steel Balls for Crushing Work.

Sheffield forges are obtaining welcome work as a result of the adoption of steel balls for crushing stone replacing the old stamp mills at the gold, silver, and copper mines, and in cement works and quarries. This work is a new, and one hopes permanent, feature of the trade. It is being shared by both the heavy and light forges, and large numbers of steel balls, varying from 1in. to 16in. in diameter, are being produced for crushing mills. The largest, which are made for special purposes, weigh something like a quarter of a ton apiece, but the call is chiefly for balls ranging from 1¼in. to 5in. in diameter, the latter weighing 18 lb. The largest crushing machines will carry as many as 30 tons of these balls, and they enable stone and ore to be reduced to a fine powder. The largest mills are installed at gold and silver mines, where they have proved extremely economical by recovering a considerable percentage of precious metal which was lost when the crushing was done with shoes and dies in the old way. Local firms are also engaged in the erection of the mills, as well as the production of the balls, and an extensive trade is being done.

Specialised Manufactures.

The report of Newton, Chambers and Co., Ltd., Thorncliffe Ironworks, Chapeltown, near Sheffield, on their trade during the past year is particularly interesting, as it gives indications of improvements taking place in several important industries. The firm states that it has found a good demand for its specialised manufactures—iron and steel work for gasworks, chemical works and blast-furnace and steel works plant. In fact, certain portions of its constructional shops have been working overtime for some time past. There has also been a good demand for special castings for automobile and locomotive work, but in other directions, partly in the light castings foundries, due to a somewhat decreased demand for housing materials, and in the production of foundry pig iron, the state of trade has not been satisfactory, though the signs are more hopeful. Rationalisation is proceeding rapidly in the gas and carbonisation trades, tending to the utilisation of large, economical and compact plant, and rendering obsolete the smaller and less economical old units. For example, the firm has just completed one of the largest purifying units ever built in this country, the iron and steel work used in the job weighing nearly 3000 tons, and the plant being able to deal with 10,000 million cubic feet of gas per annum. The firm has also just built the second, and has in hand the third, unit of three blast-furnaces in South Wales, which, besides being able to turn out nearly 200,000 tons of iron each per annum, have a fuel consumption as good as the best American practice, and have the very latest handling and charging equipment. A number of steel works have been equipped by this firm with automatic gas producers and automatic combustion control apparatus.

Waterworks Schemes.

The Ewden Valley Waterworks of the Sheffield Corporation have been brought almost to the point of completion, and it is anticipated that they will be ready about March. They have been under construction since 1914, and comprise the Broomhead reservoir of 1142 million gallons capacity, the More Hall reservoir of 480 million gallons, a service reservoir at Wadsley on the borders of the city with a capacity of 10 million gallons, and 12 miles of trunk mains. The Paterson pressure filtration plant, comprising thirty-two units, each 8ft. in diameter, has been installed, and the laying of the trunk mains of 36in. to 15in. diameter from the Broomhead reservoir for conveying water to the service reservoirs at Wadsley and Moonshine, and forward to Sheffield, is nearly completed. The total expenditure on the entire scheme is £1,737,278. The troubles of Howden, East Yorkshire, in respect of the obtaining of an adequate water supply seem to be approaching an end. The district has been inadequately supplied for some years, but an unconditional offer has been made by Mr. J. E. Mortimer, of Eastrington, of the Asselby Waterworks, which were acquired by him when he recently purchased the property of the Knedlington Manor estate on which they stand. The waterworks, which are connected with a very large water supply, have remained idle for many years. Although the supply may have deteriorated, it is believed that expenditure on restoring it will be worth while.

Lowmoor Collieries.

It is intimated that Thos. W. Ward, Ltd., of Sheffield, who recently acquired the Lowmoor Company's properties, have come to an arrangement with certain under-managers, deputies, and men to work two of the smaller pits—Coates and Hartshead No. 1. The arrangement is being put into force immediately.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipbuilding Activity.

PREPARATIONS are now being made at several North-East Coast shipyards to increase operations, and to lay keels in berths which have been idle for years past. Well on towards 100 new ships have been ordered from North-East Coast firms during the past ten weeks, and as it is known that more work is in prospect, the outlook for a few months ahead is more settled and encouraging than has been the case for a considerable time past. In other post-war years trade has brightened in the spring, but unfortunately the depression in the later months of the year became acute again. On this occasion, however, optimism as regards a trade revival is based on more solid grounds, and there are indications which justify the belief that this year will turn out better than immediately preceding years concerning shipping, shipbuilding and other industries. What is to be hoped and looked for is a steady flow of orders to take the place of the vessels launched. Construction is very rapid nowadays, and it is estimated that one order per day is necessary to keep the yards going on the North-East Coast. This week the Furness Shipbuilding Company, Middlesbrough, has received an order from a Canadian firm of owners for a cargo vessel of a new type. Designed for the transport of cement, coal, or gypsum, the vessel is to be a self-unloader, and will, it is believed, be the first of its kind to be built in England. The length will be 258ft., and the tonnage 3500 tons. There is a prospect of further orders from the same quarter. The increased activity in shipbuilding is having an appreciable effect on the iron and steel industry, especially as all North-East Coast shipbuilders are now pledged to purchase home manufactured steel.

Cleveland Iron Trade.

Business is now broadening out in the Cleveland pig iron trade, and the outlook is distinctly hopeful. Makers adhere firmly to their fixed prices, though their stocks have been materially augmented during the holidays, and pig iron makers in other areas are still underselling the products of this district in certain markets. The needs of the Cleveland pig iron producers' consuming departments are growing, and it is expected that other home needs will necessitate increased buying, while a little expansion in the export trade is looked for. The Linthorpe-Dinsdale Smelting Company, Ltd., is to restart a blast-furnace at its Dinsdale Ironworks this week-end. There are two furnaces at these works. One is already in blast and manufacturing ferro-manganese, which will also be the product of the second furnace. Furnaces in operation on the North-East Coast will accordingly be increased in number to thirty-four. No. 1 Cleveland foundry iron is 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

Enlargement of production of East Coast hematite pig iron by one of the two furnaces restarted at the Ayresome Ironworks, Middlesbrough, is very welcome, as, for weeks past, supply has been inadequate to the steadily expanding requirements of home and continental consumers. Quotations vary a little, but it is difficult to place orders at below the equivalent of 71s. for ordinary qualities.

Ironmaking Materials.

Difference of ideas between buyers and sellers as to values continues to hold up business in the foreign ore trade. Market rates are based on fully 22s. 6d. c.i.f. Tees for best Rubio. Blast-furnace coke is in better request, but local consumers are still disinclined to enter into extensive contracts. Good medium kinds are 17s. 6d. to 17s. 9d. delivered to works on the North-East Coast.

Manufactured Iron and Steel.

The demand for manufactured iron and steel is steadily expanding, and works are more active than for many months past. In several branches production is on a large scale. Specifications for shipbuilding requisites promise to be more freely distributed in the near future, and producers of various descriptions of railway material hope to book further orders. Makers of all kinds of sheets are well sold and plant is expected to be kept running at full capacity for several months. Quotations are steady and firm.

A Year's Exports of Iron and Steel.

Statistics of exports of pig iron, manufactured iron and steel from the Cleveland district during the past year reveal some interesting and encouraging facts. There was an increase of about 44,000 tons in exports of pig iron, and it was effected without any reduction in the prices of Cleveland pig iron. The increase would undoubtedly have been greater but for the keen competition of Midlands iron. Cleveland ironmasters have stemmed the flood of foreign imports into the immediate district, but they still have to meet severe competition from the Midlands, and iron from that area has, to some extent, superseded Cleveland iron in the Scottish market. However, Cleveland did a bigger volume of trade in pig iron with Scotland than it did in 1927, the increase amounting to 27,000 tons, and foreign shipments increased by an almost equal amount. The foreign exports of pig iron were fairly evenly distributed, but it is interesting to observe that after virtually a blank year in 1927, a few thousand tons of pig iron, mainly ferro-manganese, were shipped across the Atlantic. At irregular intervals Cleveland has been able to do a substantial volume of trade with the United States, and as pig iron prices are high in the United States at present, easier freights might open a considerable market there for the disposal of Cleveland iron. Manufactured iron and steel shipments from Cleveland fell from 858,572 tons in 1927 to 736,171 tons in 1928. An increased trade was done with the Argentine, but there was a decline of about 30,000 tons in the volume of Indian trade due to the higher tariff walls, and the contraction in the Australian trade amounted to about 40,000 tons.

The Coal Trade.

The Northern coal trade continues to show a good general undertone, and on the whole the outlook for the first quarter of the year is bright. Business for over the year offers sparingly, but buyers hold for the minimum fixed basis prices, and consequently transactions mature slowly. To the end of this month the position is strong, and buyers find not only difficulty in obtaining supplies, but discounts are out of the question. The cold weather is causing gas coal producers to look forward to a brisk increase in the demand. Best Durham gas coals are heavily booked to the end of the month and producers have no difficulty in clearing any surplus, but so far have not been able to force any appreciation in price. Best qualities are quoted at 14s. 9d., and seconds at 13s. 3d. to 13s. 6d. There is also more stir in coking coals, which indicate a slightly firmer tone. Bunkers are a strong section, and prices are well maintained. Large steams are the best feature of the Northumberland trade. Collieries are disposing of all their output, and demand continues on a very active scale. Best steams are quoted at 14s. 6d. and seconds at 13s. 6d. Steam smalls still require more trade, but prices are unaltered. There is little change in the coke

trade position. Demand for patent cokes is moderate, but as sellers continue to hold steadily at 18s. 6d. to 19s., buyers are inclined to hold off in the hope of securing concessions later on. Beehive coke remains firm at 25s. to 28s. Gas coke is in slow demand, and, with abundant stocks, prices are barely steady at 18s. 6d.

Blast-furnacemen's Wages.

As a result of the quarterly ascertainment, the wages of blast-furnacemen employed at North-East Coast ironworks have been advanced by 0·25 per cent. The average net selling price of No. 3 Cleveland pig iron, which governs the men's wages under a sliding scale, was certified at 63s. 4·05d. for the past quarter. The price for the preceding three months was 63s. 1·91d.

SCOTLAND.

(From our own Correspondent.)

Holiday Influences.

THE New Year holidays are now virtually at an end, but markets continue quiet owing partly to the fact that production generally has not yet assumed recent proportions. While business, therefore, is practically at a standstill, a more confident feeling prevails, chiefly owing to increased activity in the shipbuilding industry, which is expected to have a beneficial effect on various industries in the near future. Considerable benefit is also anticipated in connection with the de-rating scheme which takes effect this year. Many are of the opinion that the tide is turning, and that the ensuing months will bring a greater degree of prosperity than has been experienced for some considerable time.

Steel and Iron.

Most of the steelworks have resumed operations. Those establishments most closely identified with the shipbuilding yards have good order books, while others, though indifferently occupied, have some inquiries which, it is hoped, may mean business to a considerable amount. Steel sheet makers are comparatively quiet meantime, but anticipate an influx of orders in the spring. The bar iron works are very quiet, but re-rollers manage to maintain a fair measure of activity. Re-rolled steel bars are still quoted at £7 15s. per ton home and £7 10s. per ton export. Pig iron is a dull market, with prices nominally unchanged.

Tubes.

The tube makers are very busy—especially producers of butt-welded descriptions—and there is some prospect of developments in the nature of expansion in the output capacity.

Scrap.

The general demand for scrap is moderate, and prices remain about 65s. for heavy steel and 62s. 6d. per ton for cast iron.

Exports and Imports.

During the past week about 9900 tons of iron ore and 1000 tons of steel and iron were unloaded at Glasgow Harbour. Exports included 8500 tons of steel and iron and 30 tons of pig iron.

Coal.

Most of the pits operating before the holidays are again in action, but outputs have not yet assumed recent proportions. Some descriptions of fuel, notably Lanarkshire splints and ells, have fair commitments over January, the former for export and the latter on home account, but new business is comparatively scarce, the shipping market being practically at a standstill so far. Aggregate shipments amounted to 120,159 tons, against 279,933 tons in the preceding week and 132,371 tons in the same week last year. Home demands have improved with the change from mild to cold weather, and the collieries are now finding little difficulty in securing higher prices. Washed nuts are somewhat irregular, doubles being the strong point at present owing to demands for general utility purposes.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

VERY steady conditions continue in evidence in the steam coal trade of this district, though perhaps the pressure is not of a uniform character. Still there appears to be no reason why shipments this week should not be equal to those of last week, when the total came to nearly 430,000 tons, which compared with just over 228,000 tons for the week ended December 28th, when, of course, the holidays caused an interruption in operations. The tonnage position is well maintained, as is shown by the returns for Monday last, when the number of waiting steamers just exceeded the number of idle loading appliances. Naturally the amount of tonnage taken up during the last week of 1928 was reduced, but for the week ended the 4th inst. the quantity reported as having been chartered came to nearly 338,000 tons, and this takes no account of the steamers which are taken up by merchants, the figure for which does not become generally known on the market. There is therefore evidence that a very fair amount of tonnage is due to come along shortly, while shipowners have reason to know that the position of collieries is much better, as they now find that collieries are not prepared to take on fresh commitments unless they get longer loading hours than have been agreed to for some time past. Stems have, in fact, become so much tighter that outward rates of freight have become rather adversely affected, more especially for the near Mediterranean and short trades, for which tonnage is on offer more freely for employment. Curiously enough, the strength of the coal market lately has not been so much for the best Admiralty large coals as for the lower grades, but doubtlessly this is only a temporary phase. It is somewhat difficult in these days to gauge exactly the general demand for coals, as so much more business is done through restricted channels than was formerly the case, but there is no doubt that there is a fair inquiry, as orders for tonnage are well maintained and chartering continues to be active. The demand from Spain is moderately good without being exactly active, and before long tenders will go in for 200,000 metric tons of locomotive coals for the Egyptian State Railways for delivery over the early part of this year. As regards the home demand, the Newport Electricity Works are in the market for 13,000 tons to 26,000 tons of small coals for delivery over three or six months.

Collieries Resume Work.

The new proprietors of Nixon's Collieries have set work going again at the Mountain Ash pits with as little delay as possible, and there is great rejoicing in that district. The pits have been idle for about three months, but on Monday a restart was made. About a thousand men commenced at all the pits, with the exception of the Navigation, though operations will be resumed there as soon as the state of trade warrants. Hopes are entertained that by the end of this week places will have been found for another 2000 men, and that within a few weeks this figure will be increased to 5000. It is understood that in future Nixon's collieries will be known as Llewellyn Nixon's, Ltd. Another satisfactory feature is that there has also been a resumption of work at the Bedwas Navigation Colliery this week. A mass meeting of the workmen decided on Monday to accept the terms of the company to work on the yardage system instead of the tonnage system, which are reported to be more favourable than was at first thought to be the case by the men. Work at the Bedwas pits has been at a standstill since November 24th. The colliery normally employs about 2300 men, and a good percentage of them resumed work on Tuesday.

Pitwood Imports.

According to provisional returns, the quantity of pitwood and pit props imported into South Wales in 1928 was 1,114,634 tons, as against 1,217,484 tons in 1927. The principal importers were Franklin, Thomas and Co., Ltd., 212,030 tons; F. W. Moorsom and Co., 141,025 tons; E. Marcesche and Co., 106,153 tons; J. Brownlie and Co., 82,635 tons; Evans and Reid, 79,335 tons; and T. P. Thomas and Co., 74,034 tons.

Current Business.

The inquiry for coals continues to be on steady lines without being altogether active, so that most collieries are in a comfortable position and are working with regularity, but the demand is not so brisk as to enable sellers to advance their prices, except possibly in a few isolated cases. Large coals of the very best quality have not been quite so well off lately for ready tonnage, but they have supplies due. Second Admiralty large coals have been well placed, while smalls have a very good market and collieries have little to sell for the remainder of this month. The markets for patent fuel and coke remain without any new feature and are comparatively quiet, while pitwood is weak at 26s. 3d. to 26s. 9d.

Canadian Engineering News.

(From our own Correspondent.)

Smelting Works Extensions.

It is announced that the Consolidated Mining and Smelting Company of Canada intends to enlarge its Kimberley concentrator by 50 per cent. In 1927 the concentrator was brought up from a capacity of 3000 tons per day to 4000 tons. It is now to be enlarged to 6000 tons per day, and this new capacity is expected to be available before the end of 1929. The Kimberley concentrator operates on ores of the Sullivan, recognised as the world's greatest silver-lead-zinc mine. Lead and zinc concentrates are shipped from Kimberley to Tadanac, the company's great metallurgical plant at Trail, British Columbia. Other plans of the Consolidated for expansion of output include a 100 tons per day enlargement of the zinc plant at Tadanac, on which work has started, to raise the capacity to 400 tons of electrolytic zinc per day, a figure which will be available some time in 1929. This enlargement will put zinc on a parity with lead, the lead refinery having been turning out 400 tons of the electrolytic product per day since the completion of last year's construction programme. A 35-ton capacity sulphuric acid plant, now under erection, marks progress in two directions—further reduction of the chemical content of the smelter fumes and preparation for the expected manufacture of triple phosphate. The company's first sulphuric acid plant, erected in 1916, makes its product by burning pyrite ore, mined and shipped separately from the Sullivan property. The new sulphuric acid plant, to be in operation shortly, will turn out 35 tons per day of 100 per cent. acid, utilising sulphur dioxide fumes, which have hitherto gone up the zinc stack, for this purpose.

A New Power Development.

Another extensive Canadian power development project has been started at High Falls, on the Lievre River, near Buckingham, Quebec, where the James Maclaren interests will spend 12,000,000 dollars on the construction of a hydro-electric station with a capacity of 120,000 horsepower, a 25,000,000 cubic feet storage reservoir, 20 miles north of High Falls, and a pulp and paper plant at Buckingham, with a capacity of 250 tons daily. The power plant, which will be similar in construction to that of the Gatineau Power Company, at Chelsea, Quebec, will be built at the foot of High Falls, where the existing dam will be raised until there is a head of water of 180ft., which will be an increase of about 20ft. The power-house will be equipped with an initial installation of three 30,000 H.P. units, and a fourth will be added at a later date. The construction of the power-house will cost approximately 5,000,000 dollars, the storage dam 1,500,000 dollars, and the paper mill about 6,000,000 dollars. The paper mill will be equipped with two 234in. machines with a capacity each of 125 tons of newsprint daily.

LAUNCHES AND TRIAL TRIPS.

TOLTEC, single-screw steamer; built by Barclay, Curle and Co., Ltd., to the order of the Cuyamel Fruit Company, of New Orleans; dimensions, 405ft. 3in. by 53ft. 2½in. by 33ft. 6in.; to carry a few passengers and fruit. Engines, four-cylinder triple-expansion, 30½in., 51in., 62in., 62in. by 48in. stroke; pressure, 200 lb. per square inch; constructed by the builders; launch, December 25th.

SYDHAV, motor vessel; built by Swan, Hunter and Wigham-Richardson, Ltd., to the order of A/S Sydhav, Oslo, Norway; dimensions, 450ft. by 60ft. 11¼in. by 32ft. 3in.; to carry oil in bulk. Engines, single-screw Wallsend-Sulzer two-stroke cycle marine oil engine; constructed by the builders; launch, December 28th.

POELAU LAUT, motor cargo vessel, built by the Netherland Shipbuilding Company to the order of Stoomvaart Maatschappij "Nederland;" dimensions, 515ft. 9in. by 61ft. by 36ft. 9in.; to carry cargo and accommodation for eighteen passengers. Engines, Diesel motors; constructed by Messrs. Sulzer; trial trip, December 28th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE DIESEL ENGINE USERS ASSOCIATION asks us to announce that its affairs are now being conducted from 307, Abbey House, Westminster, S.W. 1, the honorary secretary in London, as successor to Mr. Percy Still, being Engineer-Captain J. Hope Harrison, R.N.

THOS. W. WARD, Ltd., of Sheffield, the recent purchaser of the Lowmoor Company's properties, asks us to announce that, in accordance with its general idea of developing those properties in the best interests of the district, it has come to an arrangement with certain under-managers, deputies, and men to work two of the smaller pits, Coates and Hartshead No. 1, and that is being done immediately.

BELL'S UNITED ASBESTOS COMPANY, Ltd., of Asbestos House, Southwark-street, London, S.E. 1, asks us to announce that, with the main object of bringing together the asbestos-cement interests of it and its group with those of Turner and Newall, Ltd., an amalgamation between the two companies has been effected. It has been agreed to dispose of the goodwill in the packings, jointings and general engineering supplies trade of these two companies to an independent company trading under the style of "Bell's Asbestos and Engineering Supplies, Ltd.," which will be responsible for the execution of all orders at present outstanding on the firm's books.

CONTRACTS.

ALLOY WELDING PROCESSES, Ltd., of 14-16, Church-street, Islington, London, has received an order for the supply of a motor generator electric arc welding plant for two operators for the Assam Bengal Railway Company.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., have received an order from the Crown Agents for the Colonies for the construction of twelve passenger locomotives and tenders of 5ft. 6in. gauge for the Ceylon Government Railways.

MIRRLEES, BICKERTON AND DAY, Ltd., Mirrlees House, 7, Grosvenor-gardens, Westminster, S.W. 1, have received orders for Mirrlees Diesel engines from (*a*) Marconi's Wireless Telegraph Company, Ltd. (two of 225 B.H.P.), for the wireless station at Abu Zaabul, Egypt; (*b*) Rafaela Power Station, Argentine, South America (one 600 B.H.P.); (*c*) Alexandria Waterworks, Egypt (one 200 B.H.P.); (*d*) Port of Spain Municipality, Trinidad (one 50 H.P.); and (*e*) Beira Works, Ltd. (two each of 330 B.H.P.), for the new electric generating station at Beira Port, Mozambique.

EDUCATIONAL INTELLIGENCE.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.—BARTLETT SCHOOL OF ARCHITECTURE.—A course of six lectures on "Steel and Reinforced Concrete Construction" will be given by Mr. F. E. Drury, M.Sc., M.I. Struct. E., Principal of the London County Council School of Building, on Mondays, at 6.30 p.m., beginning January 28th, 1929. Fee for the course 10s. 6d. No fee is charged to full-time students of the School of Architecture. Application for tickets of admission should be made to C. O. G. Douie, Secretary, University College, London (Gower-street, W.C. 1).

L.N.E.R. PASSENGER ENGINE.—Since the publication of our last issue, we have been informed by Mr. Gresley that the tractive effort of his 4–6–0 three-cylinder engine is 25,380 lb., not 24,379 lb., and that the adhesive ratio is 4·74.

THE INSTITUTE OF METALS.—The Institute of Metals registered its two thousandth member by the end of 1928—the twentieth year of the Institute's existence. Steps are now being taken to commemorate the Institute's coming of age in March. In addition to the annual general meetings on March 13th and 14th, there will be a dinner and dance on March 13th and a conversazione at the Science Museum on March 14th. An election of members is due to take place on January 16th.

DIAGRAM CALCULATORS FOR STEEL BEAMS.—We have received from Mr. W. G. Shipwright, of 53, Victoria-street, London, S.W.1, a diagram calculator No. 1, which has been prepared for horizontal steel beams and forms part of a series of diagrams relating to various civil engineering data, including reinforced concrete. By means of the diagram the girder required for a given span and load can be ascertained by lining up the span given on the left of the diagram with the load on the right and reading a centre figure which gives the Ift. value. On the back of the diagram there is a table, in which practically all the standard sections are given in order of strength so that a suitable section can be chosen. Other diagrams on the same sheet deal with the different distribution of loads on beams and cantilevers, and the special case of steel floors into which an area factor enters. The diagrams are mounted on stout cardboard and are complete with an engraved transparent celluloid liner, and they should be of service to both architects and engineers. They can be obtained either from dealers in drawing-office supplies or from the address given above.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	17/6 to 19/–
(1) Spanish	21/–
(1) N. African	21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 15 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 12 0	3 12 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 0 to 2 16 0	—
Forge	2 11 6 to 2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0	—
Forge	2 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 6	—
No. 4 Forge	2 17 6	—
Basic	3 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (a) / 4 2 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 8 17 6	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 12 6 to 13 15 0

STEEL (continued).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	8 17 6	—
,, (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 12 6 to 9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	6 17 6 and 7 12 6	—
Soft Basic	6 12 6	—
Hoops	9 5 0 to 9 10 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 5 0 to 6 7 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 15 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	226 0 0
,, ,, (three months)	225 10 0
Copper (cash)	74 5 0
,, (three months)	73 0 0
Spanish Lead (cash)	22 3 9
,, ,, (three months)	22 11 3
Spelter (cash)	26 7 6
,, (three months)	26 11 3
MANCHESTER—	
Copper, Best Selected Ingots	77 15 0
,, Electrolytic	79 0 0
,, Strong Sheets	102 0 0
,, Tubes (Basis Price), lb.	0 1 2½
Brass Tubes (Basis Price), lb.	0 1 0½
,, Condenser, lb.	0 1 2½
Lead, English	23 15 0
,, Foreign	22 12 6
Spelter	26 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 10 0	7/–
,, ,, 8 p.c. to 10 p.c.	£20 0 0	6/–
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/–
,, ,, ,, 1 p.c. carbon	£37 0 0	15/–
,, ,, ,, 0·70 p.c. carbon	£42 0 0	17/–
,, ,, ,, carbon free	1/– per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/– per unit	
,, Vanadium	14/– per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/– per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/–
,, ,, Ell	16/–
,, ,, Splint	16/6 to 17/–
,, ,, Trebles	14/6 to 15/–
,, ,, Doubles	13/3 to 13/6
,, ,, Singles	13/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	16/6
,, ,, Trebles	16/–
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/9 to 13/6
Screened Navigation	18/–
Trebles	15/– to 15/6
Doubles	13/9 to 14/–
Singles	12/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6 to 14/–
Secondary Steam	13/3
Trebles	15/– to 15/3
Doubles	13/9 to 14/–
Singles	12/9

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		23/–
Household		38/6 to 51/–
Coke		22/–
NORTHUMBERLAND—		
Best Steams		14/6
Second Steams		13/6
Steam Smalls		9/–
Unscreened		12/– to 12/6
Household		21/– to 27/–
DURHAM—		
Best Gas		14/9
Second		13/3 to 13/6
Household		21/– to 27/–
Foundry Coke		18/– to 19/–
SHEFFIELD—		
Best Hand-picked Branch	26/– to 27/6	—
Derbyshire Best Bright House	23/– to 24/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	17/– to 18/–	—
,, ,, Nuts	16/– to 18/–	—
Yorkshire Hards	14/6 to 16/–	—
Derbyshire Hards	14/6 to 16/–	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/–	—
Smalls	3/6 to 4/–	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		19/– to 19/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/– to 19/3
Best Dry Large	18/6 to 19/–
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	17/9 to 18/–
Western Valley Large	17/3 to 17/6
Best Eastern Valley Large	17/– to 17/3
Ordinary Eastern Valley Large	16/6 to 16/9
Best Steam Smalls	12/9 to 13/3
Ordinary Smalls	10/6 to 12/6
Washed Nuts	18/– to 24/–
No. 3 Rhondda Large	19/6 to 20/–
,, ,, Smalls	14/– to 14/6
No. 2 ,, Large	16/– to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	11/– to 12/–
Foundry Coke (export)	27/– to 37/–
Furnace Coke (export)	19/– to 21/–
Patent Fuel	20/– to 21/6
Pitwood (ex ship)	26/– to 26/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	34/– to 35/6
Seconds	24/6 to 28/6
Red Vein	22/– to 27/–
Machine-made Cobbles	40/– to 43/6
Nuts	36/– to 43/6
Beans	23/6 to 25/–
Peas	16/6 to 17/6
Breaker Duff	8/3 to 8/9
Rubbly Culm	9/– to 9/6
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	10/– to 12/6
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated. coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trans-Saharan Railway.

THE Commission which was appointed a few months ago to investigate the possibility of constructing a railway across the Sahara is expected to present its report at the end of the present year. There are many technical objections to the construction of such a line, and a certain scepticism as to whether the cost would be justified by the traffic that could be carried on it. The scheme was originally of a military character, but it is clear that its execution must depend solely upon the certainty of obtaining adequate economic results. An active propaganda is, therefore, being carried out by the various Colonial interests with the object of convincing the public that the Trans-Saharan Railway is indispensable for the opening up of the vast territories in the Upper Volta and the Niger Valley. Additional value is given to the scheme by the prospect of connecting up the railway with the system in the Belgian Congo and with the South African railways, so that there might be direct communication with Madagascar, and it is hoped that the traffic between London and the Cape will be diverted over the French line. Still more importance is attached to the possibility of the Trans-Saharan Railway facilitating a vast cotton growing industry in the Niger Valley, so that eventually the African Colonies may supply France with all the cotton wool and other raw material needed for the home manufacturing industries. There are at least three routes that have been more or less prospected, and the one to which special prominence is given at the moment starts from Oran and terminates at the Niger. The line will have a normal gauge and will be built to transport heavy loads at high speeds. A serious problem is to decide upon the method of traction to be adopted on a line traversing a desert where there is an absence of fuel and water. The Diesel-engined locomotive is usually preferred, but other suggestions have been made. Meanwhile, the preparation work for the railway, if it is carried out, will be facilitated by the air routes which are to be organised between Oran and the Niger.

Coal.

As blast-furnace proprietors have to rely largely upon foreign, and particularly German, supplies of coke, some of them are securing an interest in French collieries with the sole object of being assured of regular supplies, without the drawback of having to submit to the exactions of German coke-oven owners. So long as the French were dependent upon the German coke producers they were placed at a great disadvantage, partly through the irregularity of supplies and partly through the price which appreciably enhanced the cost of iron and steel. In France, most of the colliery companies are now making good metallurgical coke, and consumers are therefore anxious to arrange with the coalowners for supplying all the coke they need. Such arrangements have been come to between Anzin and the Aciéries de la Marine and between the Mines de Vicoigne, Drocourt and Noeux and the Aciéries de Pompey. In both cases the steel companies help to finance the collieries, and they are under the same direction. It is expected that this arrangement will have the effect of consolidating the French colliery industry and of strengthening it against foreign competition. On the other hand, the situation of the collieries in the Loire basin remains precarious. The liquidation of one of the oldest colliery companies in the district has convinced the miners that they have gone too far in their claims for higher wages, and the strike is therefore weakening.

Rail and Road Traction.

Following upon the policy they adopted of securing some control over all means of transport, and particularly road vehicles, the various railway companies have made considerable progress with the organisation of motor car services. Each has a subsidiary company which usually arranges with private concerns to run the vehicles over particular routes, and the cars have to be built to the companies' specifications, whereby it is sought to obtain the maximum safety, comfort and economy. The P.L.M. Company is now running more than 200 motor car services, chiefly between the railway and the touring centres. Even when the road services would appear to compete directly with the railway, they are organised in the interests of the public, as, for instance, that between Marseilles and Avignon. So far, the policy of the railway companies to control the road services has given satisfactory results, and judging from the way in which those services are being developed, there appears to be some reason for believing that the problem of meeting the competition of motor vehicles is in a fair way of being solved.

Steamship Exhibition.

Coinciding with the annual Colonial Fair, which will be held at Marseilles next year, a retrospective exhibition will be organised to commemorate what will be nearly, though not quite, the centenary of the first regular steamboat service in that port. The Marseilles Chamber of commerce is anxious to secure the loan of anything relating to the history of steam shipping down to the end of the nineteenth century, either in the form of models, documents, posters, engravings or anything else that might add to the interest of the Exhibition. At the same time, there will be much to show the extraordinary progress that is being made by Marseilles in the way of port extensions and improvements with a view of developing trade with North Africa, facilitating traffic with the East, and providing for the future traffic by inland waterways from Central Europe. The construction of the Rove Tunnel, the equipment of the Caronte leading into the Etang de Berre and the new extensive docks to be laid out in accordance with the programme which was started upon about fifteen years ago, has involved the carrying out of many interesting works, and will, when completed, provide ample accommodation for shipping in the future.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

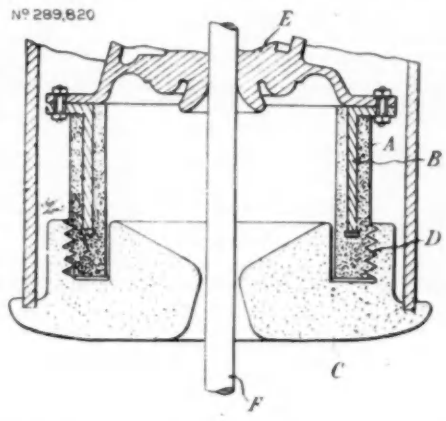
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

289,820. May 2nd, 1928.—OIL SWITCHES WITH EXTINGUISHING CHAMBERS, *International General Electric Company, Inc., of 120, Broadway, New York.*

In practice, it has been found that, owing to the heat developed by the arc which is set up when an oil switch is opened, the bottom member used in explosion pots of oil switches wears out more rapidly than the other portions of the explosion pot, so that in many cases it has to be replaced when these other portions are still in a proper working condition. In those cases in which the bottom member is not readily detachable from the casing member this necessitates a renewal of the entire insulating

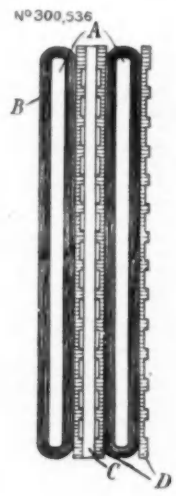


coating for the casing in addition to the bottom member. An explosion pot for oil switches constructed in accordance with this invention comprises a body member A having a metallic core B provided with an internal and an external lining of insulating material made in one piece and pressed on to the core B. The bottom member C is made wholly of insulating material formed in a single piece and provided with a screw-threaded portion D, whereby it is detachably secured to the body member A. The bottom member C is provided with an aperture for the passage of the switch rod F and serving also for the escape of heated air. The contact sleeve is indicated at E.—*November 29th*, 1928.

BATTERIES AND ACCUMULATORS.

300,536. August 13th, 1927.—IMPROVEMENTS IN OR RELATING TO SECONDARY BATTERIES, The D.P. Battery Company, Ltd., and John Waddell, both of Lumford Mills, Bakewell, Derby.

According to this invention, a band or strip of glass wool felt completely encircles both faces and both edges of certain plates

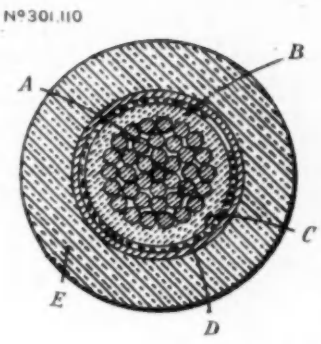


or every plate of a secondary battery. In the illustrations only the positive plates A are shown provided with glass wool felt wrapping bands, which are indicated at B, the negative plates C being assembled on either side with or without a separating plate D.—*November 13th*, 1928.

TRANSMISSION OF POWER.

301,110. August 26th, 1927.—FLEXIBLE ELECTRIC CONDUCTORS, Callender's Cable and Construction Company, Ltd., Philip Vassar Hunter, both of Hamilton House, Victoria Embankment, London, E.C. 4, and Harold John Allcock, of the Red Cottage, Pond-road, Blackheath, London, S.E. 3.

The object of this invention is to provide an insulated flexible conductor, the strands of which can expand in a radial direction. The strand A is passed through a known form of extruding machine containing flexible resin in a molten state containing from 10 per cent. to 20 per cent. of impregnating oil. The thickness of the resin layer B is regulated by the size of the front die and by the temperature at which the machine is maintained. Alternatively the strand may be passed through a bath of resin maintained at a predetermined temperature, surplus resin being removed by passing the strand through a heated die. A tape C of phosphor-bronze or copper is then wound upon the resin coated strand to form a support for the insulation. The helix so formed may be gapping or overlapping, but in either case a metallised paper D is preferably wound over the tape with its metal surface in contact therewith. The main insulating wall E is then applied in any known manner and the cable is then com-



pleted in the usual way, *i.e.*, in the case of a multi-core cable it is then cored up. The cable is then dried and impregnated in the known manner and during these processes some of the resin is melted out while drying, the remainder being diffused in the impregnating compound during impregnation. Alternatively, before the insulating paper D and the main insulating wall E are applied the strand A with its coating of resin B and lapping of metal tape C may be slowly passed through a heated zone, thus melting and removing the layer of resin B before either the paper strip or insulating wall is applied.—*November 26th*, 1928.

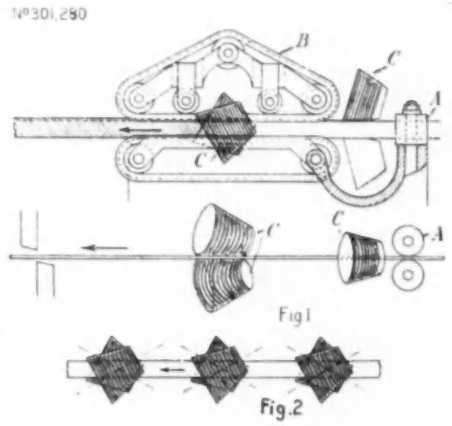
MACHINE TOOLS AND SHOP APPLIANCES.

301,221. December 20th, 1927.—IMPROVEMENTS IN OR RELATING TO ELECTRODES FOR ELECTRIC WELDING OR SOLDERING, Alloy Welding Processes, Ltd., and Edward John Clarke, both of 14–16, Cockspur-street, Charing Cross, London.

According to this invention, a quantity of sawdust is included in the coating of electric welding electrodes. The ingredients of the coating depend upon the nature of the core metal of the electrode and the purpose for which the electrode is to be used and the nature and proportions of the ingredients can be varied considerably. For electrodes for use in the welding of iron and steel a suitable coating composition can, for example, be prepared from the following ingredients:—Felspar, 1 part; fluorspar, 1 part; calcium carbonate, 1 part; sawdust, 1 part; and sodium silicate solution, 40 deg. Twaddle, 1 part. For electrodes for use in the welding of copper, brass and bronze the ingredients of a suitable coating composition may comprise, for example:—Fluorspar, 3 parts; alkaline silica glass, 4 parts; sawdust, 4 parts; chalk, 3 parts; and sodium silicate solution, 40 deg. Twaddle, 5 parts. The various solid ingredients of the coating are first ground together to a fine powder and then made into a smooth paste by the addition of the sodium silicate solution. If desired, however, the sodium silicate can be omitted and the paste made by the addition of water alone to the powder, or, for a harder setting mixture than that obtained with water alone water may be used with some dextrine or other agglutinant. The paste is applied to the metal core in any convenient way and then dried. With electrodes made in accordance with the invention a reducing atmosphere is created around the arc so that the metal can be deposited without coming into contact with any free oxygen or oxy-generating compound.—*November 29th*, 1928.

301,280. May 15th, 1928.—MAKING MILLED FILES, A. Peiseler, Clarenbach 23, Remscheid-Haddenbach, Germany.

The inventor proposes to mill the teeth of files by a continuous process from strip blank. The blank is fed into the



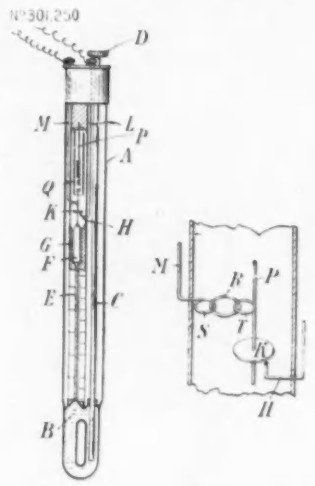
machine by the rolls A A and the endless chains B B. The teeth of the file are cut by the conical milling cutters C C C, which have helical teeth. On reference to Fig. 2, it will be seen that by appropriately orientating the cutters the whole width of the file is acted upon.—*November 29th*, 1928.

LIGHTING AND HEATING.

301,250. February 13th, 1928.—TEMPERATURE REGULATING DEVICE FOR ELECTRICAL HEATING APPARATUS, Dr. Willi Stuwe, of Mulhausen in Thuringia, Germany.

The invention concerns temperature regulating devices for electrical heating apparatus enabling a definite temperature to be maintained. The casing A, which is provided at its lower extremity with a vessel for mercury B, is also provided with a rod C of glass or china, which protrudes with a knob D through a seating in the cap. This rod is preferably graduated and can be immersed by sliding it, more or less, deeply into the mercury vessel. By this means the mercury column is caused to rise more or less in the capillary tube E in such a manner that the float F provided in the enlargement G is lifted at the moment when the predetermined temperature is reached, and thereby breaks the contact between the parts H and K and thus opens the electric circuit comprising the conductors L and M con-

nected to the terminals. The float F is suspended from a thin wire P having a spiral spring Q. The supply of current to the contact plate K in the example illustrated is obtained from the

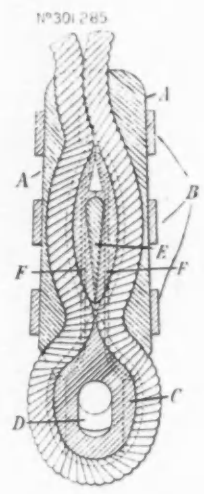


supply conductor M connected to the suspension wire P by means of a wire hoop R which is loosely engaged in the wire loop S on the supply conductor M and also in the wire loop T on the suspension wire P.—*November 29th*, 1928.

MISCELLANEOUS.

301,285. June 13th, 1928.—A Capel for Wire Ropes, J. S. Sparkes, 34, Merchants' Exchange, Cardiff.

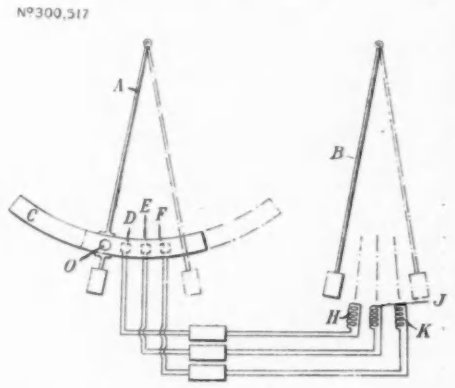
The body of this capel is in two pieces A A, and is held together by the bands B. The load is shackled on through the thimble



C. The shackle pin also passes through a hole in the bottom of the link D. This link, at the top, is connected with the wedge E, which forces apart the pieces F F and consequently grips the rope.—*November 29th*, 1928.

300,517. May 13th, 1927.—Synchronising Mechanisms, John Logie Baird and Baird Television Development Company, Ltd., of Motograph House, Upper St. Martin's-lane, London, W.C. 2.

The pendulum indicated at A is a master pendulum with which a second pendulum B is required to operate synchronously—that is to say, at the same rate and in phase with the first pendulum. The pendulum A is provided with a shield C having an opening D. The shield C is preferably of such dimensions that whatever may be the position of the pendulum A a part at least of its path is always shielded by the part C. Within this



shielded part of the path there is arranged a series of light-sensitive cells D E F, and a source of light is situated in such a position as to throw a beam of light on the shield C so that as the opening D in the shield passes each of the light-sensitive cells it exposes it to the lamp. Each cell is thereby activated, and the currents or current impulses from the respective cells are amplified in suitable devices and transmitted to the second pendulum. As indicated diagrammatically, the currents from the respective cells, after amplification, are applied to electro-magnets H J K, these magnets being spaced apart along the path of movement of the pendulum B in similar positions to the light-sensitive cells D E F. The pendulum B carries a suitable armature to co-operate with the electro-magnets. The operation of the apparatus is self-explanatory.—*November 13th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday o the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Electrical Engineers: North-Eastern Students' Section.—Armstrong College, Newcastle-on-Tyne. "The Stability of Pilot Wire Protective Systems for Alternating-current Feeders," by Mr. E. W. M. Scott. 7.15 p.m.

Junior Institution of Engineers.—At 39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Developments in Spraying Apparatus," by Mr. F. E. Webb. Exhibits and demonstrations. 7.30 p.m.

Keighley Association of Engineers.—In Room 14, Temperance Institute, Keighley. "Tooling Equipment for Capstan and Turret Lathes," by Mr. E. W. Field. 7.30 p.m.

Manchester Association of Engineers.—Midland Hotel, Manchester. Annual Dinner. 6.45 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "The Rational Utilisation of Coal: (*a*) Coal Used in its Raw State," by Mr. W. J. Drummond; (*b*) "Fuels Obtained by the Treatment of Coal," by Mr. W. T. K. Braunholtz. 6 p.m.

Society of Chemical Industry: Chemical Engineering Group.—In the House of the Royal Society of Arts, 18, John-street, Adelphi, London, W.C. 2. "The Relative Safeties of Mild and High-tensile Alloyed Steels Under Alternating and Pulsating Stresses," by Professor B. P. Haigh. 8 p.m.

SATURDAY, JANUARY 12TH.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—At the College of Technology, Sackville-street, Manchester. "The Relationship of the Drawing-office, Pattern Shop and Foundry," by Mr. H. N. Riley; "Some Moulding Difficulties, and How They Were Overcome," by Mr. Harry Morris; "The Designing of Castings Relative to the Work of the Foundry," by Mr. E. Suteliffe. 7 p.m.

Institution of Civil Engineers.—Students' visit (afternoon) to the Deptford West Power Station of the London Power Company, Ltd.

Institution of Electrical Engineers: North-Eastern Students' Section.—Visit to the Bede Metal and Chemical Company, Hebburn. 3 p.m.

MONDAY, JANUARY 14TH.

Institute of Metals: Scottish Local Section.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Recent Developments in the Manufacture of Condenser Tubes," by Mr. A. Spittle. 7.30 p.m.

Institution of Automobile Engineers.—Queen's Hotel, Birmingham. "Coil Ignition," by Dr. F. W. Lanchester. 7 p.m.

Institution of Automobile Engineers.—The College, Loughborough. Graduates' meeting. "Purchasing," by Mr. E. C. Thompson. 7 p.m.

Institution of Electrical Engineers: Western Centre.—The Grand Hotel, Bristol. Annual dinner. 6.30 p.m. for 7 p.m.

The Society of Engineers.—In the Apartments of the Geological Society, Burlington House, W. "The Vacuum Power Oil Lamp," by Major E. Scott-Snell; and "Neu-flame," by Mr. Charles Scott-Snell. 5.30 p.m.

TUESDAY, JANUARY 15TH.

Institute of Metals: North-East Coast Local Section.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Some Aspects of Steam Turbine Development and Application," by Mr. R. Dowson. 7.30 p.m.

Institution of Automobile Engineers.—Informal meeting of the Coventry Centre at the Rover Sports Club, Albany-road, Coventry. "Brake Systems" will be discussed. 7.30 p.m.

Institution of Electrical Engineers: North Midland Centre.—The Hotel Metropole, Leeds. "Recent Developments in Electricity Meters, with Particular Reference to Those for Special Purposes," by Mr. J. L. Carr. 7 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "America," by Mr. J. H. S. Dickenson and Dr. W. H. Hatfield. 7.30 p.m.

WEDNESDAY, JANUARY 16TH.

Institute of Fuel.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W. 1. "Continental Experience in Pulverised Fuel Practice," by Messrs. Berg and Erich Vogt. 6 p.m.

Institution of Automobile Engineers: Birmingham Graduates.—At the Queen's Hotel, Birmingham. "Accessory Mechanisms," by Mr. R. Sedgwick. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Informal meeting. Subject for discussion, "Merits and Demerits of Alternative Methods of Taking Water for Modern Power Stations from Tidal Waters," by Mr. H. H. Dalrymple-Hay. 6 p.m.

Junior Institution of Engineers: Sheffield and District Local Section.—In the Cutlers' Hall, Sheffield. "Early Aviation," by Lieut.-Col. J. T. C. Moore-Brabazon. 7.30 p.m.

Northampton Engineering College Engineering Society.—St. John-street, E.C. 1. "Low-temperature Carbonisation in Great Britain," by Mr. R. C. Burden, B.Sc. 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section. Discussion on "Steam Engine Machinery *v.* Diesel Machinery," introduced by Messrs. H. Caird (shipbuilder) and W. S. Paulin (engineer). 7.15 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, S.W. 7. Annual general meeting. "Amateurs as Pioneers," by Sir Richard Gregory. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "The Domestic Smoke Problem: A Practical Solution," by Professor C. R. Darling. 8 p.m.

THURSDAY, JANUARY 17TH.

Institute of Metals: Birmingham Local Section.—In the Engineers' Club, Waterloo-street, Birmingham. "Refractories for Use in Metallurgical Furnaces," by Mr. A. J. Dale. 7 p.m.

Institution of Civil Engineers: Birmingham and District Association.—Visit to Dunlop Rubber Works. 2 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—At the Hotel Metropole, Leeds. Annual general meeting. "Power Transmission by Belts," by Dr. H. W. Swift. 7.30 p.m.

School of Engineering and Navigation.—High-street, Poplar, E. 14. Prize Distribution by Mr R. W. Allen. Open night. 7 p.m. to 10 p.m.

The Optical Society.—At the Imperial College of Science and Technology, Imperial Institute-road, South Kensington. "The Function of the Lens Capsule in the Accommodation of the Eye," by Mr. E. F. Fincham; "A Double Reflexion Level," by Dr. D. S. Perfect; "Photographs of Reflexion Caustics," by Mr. T. Smith, Dr. John S. Anderson, and Mr. L. C. Cordle. 7.30 p.m.

FRIDAY, JANUARY 18TH.

Institution of Automobile Engineers: Scottish Graduates.—At the Regent Restaurant, 51, West Regent-street, Glasgow. "Dynamometers," by Mr. J. Swan. 8 p.m.

Institution of Chemical Engineers.—At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. "The Reactivities of Solid Carbon in Fuel Processes," by Professor J. W. Cobb. 6.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. General meeting. "Modern Feed Water Circuits," by Mr. J. G. Weir. 6 p.m.

Junior Institution of Engineers.—At 39, Victoria-street, S.W. 1. Ordinary meeting. "Notes on the Fitting and Operation of Michell Bearings," by Mr. J. Foster Petree. Slides. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "Further Progress in Crystal Analysis," by Sir Wm. Bragg, F.R.S. 9 p.m.

SATURDAY, JANUARY 19TH.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Greenwood's Café, Todmorden-road, Burnley. Annual reunion. 5 p.m.

MONDAY, JANUARY 21ST.

Institution of Automobile Engineers.—Meeting of the Scottish Centre at the Royal Technical College, Glasgow. "Safety in Four-wheel Braking Systems," by Mr. M. Platt. 7.30 p.m.

Institution of Automobile Engineers.—Joint meeting of the Western Centre and the West of England Branch of the Institution of Mechanical Engineers, at the Merchant Venturers' Technical College, Unity-street, Bristol. "Recent Developments in the Study of the Fatigue of Materials," by Dr. H. J. Gough. 6.45 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Graduates' Section, London. Joint meeting with Students' Sections of Institution of Civil Engineers and Institution of Electrical Engineers. "Engineering Insurance," by Mr. H. R. Sketch. 6.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London W.C. 2. Cantor lecture. "The Treatment of Coal," by Dr. C. H. Lander. Lecture I. 8 p.m.

TUESDAY, JANUARY 22ND.

Illuminating Engineering Society.—In the Lecture Theatre of the Home Office Industrial Museum, Horseferry-road, Westminster, S.W. 1. "Colour and its Applications," by Dr. L. C. Martin, followed by a discussion. 6.30 p.m.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C. 2. London Graduates' informal meeting. "The Training of Drivers," by Mr. J. F. Ward. 7.25 p.m.

Institution of Automobile Engineers: Coventry Graduates.—At the Broadgate Café, Coventry. "Jigs," by Mr. Wheeler. 7.15 p.m.

Institution of Automobile Engineers.—Engineering and Scientific Club, Queen-street, Wolverhampton. Meeting. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, S.W. 1. "The Vibrations of Roads and Structures," by Messrs. James H. Hyde and H. R. Lintern. 6 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Mining Institute, Neville-street, Newcastle-on-Tyne. Joint meeting with the Newcastle and District Association of the Institution of Civil Engineers. "The Development of Generation and Distribution of Electrical Power in the British Isles," by Mr. A. Page. 7.30 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "The Applications of Electro-deposited Metals to Engineering," by Mr. C. H. Faris. 7.30 p.m.

WEDNESDAY, JANUARY 23RD.

Institution of Automobile Engineers.—Engineers' Club, Manchester. "Safety in Four-wheel Braking Systems," by Mr. M. Platt. 7 p.m.

FRIDAY, JANUARY 25TH.

Institution of Electrical Engineers: North-Eastern Students' Section.—Armstrong College, Newcastle-on-Tyne. "The City of Winnipeg Hydro-electric Power Station," by Mr. S. Gibson. 7.15 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. "Measurement of Coal Supplies in Small or Large Quantities," introduced by Mr. J. E. Lea. 7 p.m.

MONDAY, JANUARY 28TH.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "The Treatment of Coal," by Dr. C. H. Lander. Lecture II. 8 p.m.

TUESDAY, JANUARY 29TH.

Institution of Electrical Engineers: Scottish Centre.—North British Station Hotel, Edinburgh. "Recent Extensions to Portobello Power Station," by Mr. E. Seddon. 7 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "The Influence of Surface Conditions and Internal Stresses on the Physical Properties of Cold-worked and Quenched and Tempered Steels, with Particular Reference to Fatigue Resistance," by Professor F. C. Lea. 7.30 p.m.

WEDNESDAY, JANUARY 30TH.

Institution of Civil Engineers.—Great George-street, S.W. 1. Students' meeting. "Design and Construction of Victoria House," by Mr. H. George Cousins. 6.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "The Shannon Scheme and its Economic Consequences," by Mr. George Fletcher. 8 p.m.

THURSDAY, JANUARY 31ST.

Institution of Civil Engineers.—Great Northern Hotel, Leeds. Annual dinner. 7 p.m.

FRIDAY, FEBRUARY 1ST.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Thomas Hawksley Lecture, "Engineering Principles in the Machinery of the Stars," by Professor A. S. Eddington, F.R.S. 6 p.m.